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# PROCEEDINGS

OF THE

# SCIENTIFIC ASSOCIATION

OF

# TRINIDAD.

December 1872.

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# PROCEEDINGS

OF THE

# SCIENTIFIC ASSOCIATION

OF

# TRINIDAD.

Part IX.] DECEMBER 1872. [Vol II—No. 1.

The regular Meetings of the Association were held on the 22nd July and 8th August 1871.

*Tuesday* 12*th September* 1871.

Robert Guppy Esq. M.A., in the Chair.

His Excellency James Robert Longden, C.M.G. was elected an honorary member.

Samuel Leonard Crane Esq. M.D., John Glanville Esq. M.R.C.S., and Thomas Cuddeford Esq. M.R.C.S., were elected members. The following Donations were announced, and the thanks of the Association ordered to be returned to the respective donors:

"The Annals of the Lyceum of Natural History of New York"—February 1869 to March 1870.—*Presented by the Lyceum.*

"The Complete Writings of Constantine Smaltz Rafinesque on Recent and Fossil Conchology"—Edited by Wm. G. Binney and George W. Tryon, jnr.—*Presented by W. G. Binney.*

"Catalogue of the Recent Species of the Family Corbiculadae"—By Temple Prime.—*Presented by the Author.*

"Fishes of Don Antonio Parra copied from the original by Lt. Colonel Hamilton Smith."—*Presented by the Hon. Richard Hill.*

"Letters of the Vice President of the Natural Academy of Sciences communicating Reports of the Proceedings of the Academy during the years 1866–7."—Washington 1867 1868.

"Tenth Annual Statement of the Trade and Commerce of Chicago."—Chicago 1868.

"Monthly Report of the Deputy Commissioner of the Revenue in charge of the Bureau of Statistics."—March 1869.

"Forty-ninth Annual Report of the Board of Controllers of Public Schools of the First School District of Pennsylvania.—Philadelphia 1868.

"Twenty-second Annual Report of the Board of Trustees of the Public Schools of the City of Washington."—Washington 1867.

"Land and Freshwater Shells of North America—Part I, Pulmonata Geophila."—By W. G. Binney and T. Bland.—Washington 1869.

"United States Sanitary Commission—Military Medical and Surgical Essays."—Washington 1865.

"——— ——— ——— A Sketch of its Purposes and its Work."—Washington 1863.

"——— ——— ——— History of the United States Sanitary Commission"—By C. J. Stillé.—New York 1868.

"——— ——— ——— The Sanitary Commission of the United States Army."—New York 1864.

"United States Sanitary Commission—Memorial of the Great Central Fair."—Philadelphia 1864.

"——— ——— ——— Record of the Metropolitan Fair." —New York 1867.

"——— ——— ——— History of the Brooklyn and Long Island Fair."—Brooklyn 1864.

"Smithsonian Report 1867."—Washington 1868.—*Presented by the Smithsonian Institution of Washington, D.C.*

"Memoirs of the Boston Society of Natural History"—Vol I, Part IV.

"Entomological Correspondence of Thaddeus William Harris."—Boston 1869.

"Proceedings of the Boston Society of Natural History." —June 1868 to March 1869.—*Presented by the Boston Society of Natural History.*

"Vargasia"—No. 7.—*Presented by the Sociedad de Ciencias fisicas y naturales de Caracas.*

"Journal of the Society of Arts"—Nos. 902–10.—*Presented by the Colonial Government.*

"Notes on some new Forms of Terrestrial and Fluviatile Molluska found in Trinidad"—By R. J. Lechmere Guppy—*Presented by the Author.*

An extract from a communication from Mr. Thomas Bland, of New York, corresponding member, respecting the cultivation of the *Boehmeria nivea*, or China Grass, was read: and Mr. Henry Prestoe promised a report on the subject.

The question of the desirability of the establishment of a public museum in connexion with the public library was discussed and strongly supported by the meeting.

*Tuesday*, 10*th October* 1871.

Robert Guppy Esq., M.A. in the Chair.

Robert William Span Mitchell Esq. was elected a member.

His Excellency Rawson William Rawson, Esq. C.B. was elected an honorary member.

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*Monday*, 13*th November* 1871.

The Association met at La Falaise, San Fernando.

Robert Guppy Esq. M.A., in the Chair.

The following papers were read:—

1. Remarks on the Cultivation of the Ramie Fibre Plant in Trinidad.

By Henry Prestoe, Government Botanist.

In fulfilment of a promise made at a former meeting of this Association to furnish some information upon the Ramie fibre Plant (*Boehmeria nivea*, Gaud.) and its cultivation, by way of reply to a circular of the United States Ramie Planting and Mining Company, which has been forwarded to this Association by its corresponding member in New York, the following remarks are submitted.

It is desired to ascertain whether the circumstances of the country, as one of the West Indian Islands, are favorable to the project of introducing among them the cultivation of the *Boehmeria nivea* with a view to produce its now well-known and valuable fibre on a large scale: now that, as is represented, the long-existing desideratum of a machine that will clean the fibre in a manner suitable for the European market, has been met.

It is not intended to consider here every point raised in the circular bearing, and of course favorably, on the cultivation of the Ramie; but with regard to such points as

are noticed, as well as to those which are not, it should be remembered that all the statements which are there made with regard to the cultivation of the Ramie, are based upon experiments which have been made in the district of New Orleans, where, it appears, the climatic conditions more nearly resemble than do those of this Island, those of certain parts of China and North India where the Ramie is indigenous and appears, under skilful cultivation, to attain the finest development.

To the interrogatory of the circular, I feel some regret that circumstances compel me to reply in the negative; the more so because, firstly, the introduction of this cultivation, valuable as it certainly is in some other countries, would, if it were practicable in this, enlarge the basis of the colonial agriculture; and secondly, because the additional American interest, which in all probability the establishing the cultivation here would attract to the colony, is not secured. It is necessary therefore to deal with only the few points which are of primary importance in considering the matter to explain on what grounds the profitable cultivation of Ramie in this Island is deemed at present impracticable

The Ramie plant is what is known technically as an herbaceous perennial—that is to say, its normal habit of growth consists of the production of stems by elongation upwards of more or less underground rhizomes; which stems, having produced seeds, die off annually, leaving a store of fleshy rhizomes below to develop into seed-bearing stems another year; such is its habit of growth in extra-tropical regions where the summer and winter are more marked by change of temperature than in the tropics; and

thus it may be expected its cultivation will be most successfully dealt with in countries of sub-tropical conditions like those of the parts in which it is indigenous. It is a plant, however, like the majority of plants originally inhabiting sub-tropical regions, of very elastic constitution, conforming itself to the conditions of a purely tropical country apparently with little deterioration. But under such influences its habit of growth becomes perpetual, and when not arrested by unusual drought, or by an undue production of abortive flower-bearing processes, to which under the tropical conditions they are very liable, the stems, instead of being *simple*, or without branches—a character due to their duration for but one season, and essential to the cultivator—assume the character in two or three seasons of a large branching shrub. There is, however, at the same time a sign of deterioratiou in the tenuity of growth, induced without doubt by the annual round of tropical, and to the Ramie plant, unnatural heat.

I am not aware that the cultivation of the Ramie plant has ever been attempted in the Island on any considerable scale. It has thriven, however, for some years in the Botanic Garden, and although it has not received any special attention in cultivation for the production of fibre, its capabilities in regard to growth can be judged of from its doings there.

As compared with tropical herbaceous plants generally, and especially with indigenous species of its own genus, it is a decidedly slow grower. Its present rate of growth would not justify an expectation that more than a double production of stems four or five feet length could take place annually. The size of the stems towards the base

varies from that of a goosequill to that of the finger. Those of the larger size could scarcely be produced in greater number with uniformity of growth, than 40 or 50 to the square yard. The foliage of the Ramie is ample, and on its healthy state depends of course the size of the stem, the bark of which yields the Ramie fibre.

The diameter of circumscription of the leaf-mass on such stems is not less than one foot. Thus, it will be obvious that little more than four to the square foot can at the same time develop strongly.

Under the influence of a tropical climate this plant is constantly though irregularly developing its rhizomes into stems, and therefore, in systematic cultivation, monthly or even fortnightly cuttings would be necessary to secure the stems in their proper degree of ripeness as they happen to reach it. The heaviest cuttings, however, would probably occur in September and February, in the northern tropics.

Abundant moisture and rich soil are clearly indispensables in successful culture of the Ramie plant, and with these many expenses must be incurred for weeding at all times, but specially at that period which intervenes between the planting and the nearly full development of the stems, by which of course the ground is wholly covered. At no time, however, can it be expected that the plants can hold their own against the numerous weedy plants of infinitely more rapid growth in tropical countries. Again, the frequent thinning, by the peculiar method of gathering the stems necessitated by the tropical conditions, would greatly encourage the development of weeds, and thus weeding must be effected to a great extent by hand for the preservation of the tender nascent stems.

These remarks on one or two of many points of like importance that would present themselves, and require to be dealt with in a special manner in prosecuting the cultivation of the Ramie here, serve to show that its introduction would not be unattended with difficulties incident to the peculiar conditions of the place; to meet which, special intelligence for the acquisition of accessories, and their application in a manner to lead to profitable results would be required. In fact the system of culture must necessarily be very different from, and much more expensive than, that indicated in the Circular of the American Ramie Fibre and Mining Company as being practised with success at New Orleans; also that specified as the Indian and China method in Dr. MacGowan's Report to the Agri-Horticultural Society of India. *

The particulars of the system of culture of the Ramie followed in India and China, as given in the Journal of the Agri-Horticultural Society of India, which were embodied in a Circular Despatch issued by the Secretary for the Colonies in 1867, and subsequently published in abstract in the proceedings of this Association, show with striking clearness that this cultivation is not less difficult than that of the sugar-cane or cotton plant. The results of the crop so clearly depending on local influences and skilled manipulation in dealing with the growing plant, as well as with the fibre, much sagacity in superintendence and precision in effecting details—ability for which can only be acquired after a long course of training—are indispensable to insure their being satisfactory.

* See Proceedings of the Scientific Association of Trinidad, vol. i., pp 137, 199, 201.

Fibre-cleaning machines of a special construction might be brought to aid largely in the manufacture of this fibre, but it is hardly to be expected that machinery will be of such efficiency as to so completely supersede the manual assistance by which the supply of Ramie fibre is at present produced that the employment of laborers skilled in the industry by long training will be rendered unnecessary.

The high price of £70 per ton, which the Indian Ramie has fetched, I am informed on good authority no longer obtains, and that price was realized by samples of exceptionally fine quality, as are the highest prices quoted at the present day, and which samples are obtained only by very skilful treatment, especially in manipulation, said to be afforded only by persons like the Ramie cultivators in China and India, who are instructed from their infancy in the art of its culture and manufacture.

The returns, as shown in the Circular of the American Ramie Fibre Company, resulting from experimental planting by Mr. Hall of New Orleans, are truly enormous, being 2,500 lbs. per acre, and much beyond what might be expected to be realized here. The calculation, however, by which these figures have been obtained, is based on an assumed production of 100 stems per square yard as a single crop, and on a production of 1 lb. of fibre for every 200 stems. I do not think, however, as I have already stated, that more than 40 good stems could be produced on the square yard here as a single crop; and in calculating from this, allowance must be made for the space taken up by paths or alleys necessarily intersecting the grounds at intervals of four feet for convenience in weeding, watering, cutting and admitting air amongst the

stems, &c., when growing, by deducting one-fifth from the total area of the acre. This would give, according to the percentage of fibre on the stem as given by Mr. Hall, and which I have good reasons for supposing would be the production here, about 800 lbs. fibre per acre, which, at a price of £60 per ton, would value about £24.

The returns that may be expected from the cultivation of the Ramie in this country being thus comparatively low, it will be obvious, that to carry it on profitably, labor and some degree of special skill in the industry must be abundant and cheap. But these conditions do not exist in this country, and therefore it can hardly be expected that, even if taken up, this cultivation will become extensively established in the colony under the disadvantages of scanty population, and consequent high priced labor, particularly as under these disadvantages there are other cultivations already well established, which might be vastly extended with certainty of remunerative results.

2. *Report of the Secretary to 30th September*, 1871.

In accordance with the wish expressed at the last meeting of the Associatien I beg to present the following report upon its condition.

On the 30th September last the Association was composed of the following numbers:

Members..... 20
Honorary Members..... 1
Corresponding Members . 10—Total 31.

Of the above 20 members 11 have expressed their desire to continue to belong to the Association, and 5 are absent from the island. From the remaining 4 no answer has

been received. Four new members and 2 honorary members have been elected since the 30th September. The death of Mr. Webbe, a corresponding member, has been announced, and an obituary notice of him will be read to the meeting.

For some time past the meetings of the Association were not as regular or as well attended as could have been wished, but the steps taken for the re-organization of the Association has resulted in increased interest in its proceedings.

It has been decided that in future the year of the Association shall commence on the 1st October. The subscriptions are then payable for the year.

The undermentioned papers have been read since the Secretary made his last report :—

1. Carr—Voyage round Trinidad, pt I.
2. Guppy—On new Marine Shells.
3. Mitchell—On manufacture of Sugar by Evaporation.
4. Guppy—On Dominica.
5. Carr—Voyage round Trinidad, pt II.
6. Guppy—On the Trinidad Public Library.
7. Webbe—On Weather.

These papers have been published in the Proceedings of the Association, Parts VII & VIII.

Great delay has taken place in the publication of the last part of the "Proceedings" notwithstanding that the price of the printing under the new arrangements with the "Chronicle" office has been increased. It is also to be regretted that the paper and printing of the last part are inferior, and with reference to this it may be suggested that an attempt should be made to have any future publications printed in England.

The last part (part VIII) of the Proceedings completed the first volume, and a titlepage and index to the volume have been prepared and issued.

HENRY F. J. GUPPY,
Secretary & Treasurer.

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MEMORANDUM
Of the *parts* of Proceedings in hand, 30 Sept.

| | | |
|---|---|---|
| Part I | .. .. .. | 7 copies. |
| II | .. .. .. | 2 „ |
| III. | .. .. .. | 7 „ |
| IV | .. .. .. | 16 „ |
| V | .. .. .. | 14 „ |
| VI & VII | .. | 22 „ |
| VIII | ... .. | 36 „ |

3. Obituary Notice of the Hon. George Webbe, F.R.A.S.

The death has lately been announced of the Hon. George Webbe, F.R.A.S., Corresponding Member of this Association. The deceased gentleman was a native of Falmouth, Cornwall, Britain. He was educated and obtained a fellowship at Balliol College, Oxford. Early in life he proceeded to the island of Nevis, where he had sugar estates. Mr. Webbe filled some of the most important offices in that island. In 1829 he was appointed Chief Justice, and continued to hold that office for twenty-six years. Subsequently he was made Colonial Treasurer and Judge of the Court of Complaints, which offices he held for nineteen years. During that period he administered the government of Nevis on three several occasions. In 1869 he retired on a pension from the public service.

Mr. Webbe's literary attainments were well known throughout the Westindies; and he has contributed to our Proceedings a paper "on Weather and Weather Predictions."

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*Tuesday* 19*th December* 1871.

Henry William Caird Esq. M.A. was elected President for the year ending 30th September 1872.

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*Tuesday* 16*th January* 1872.

Henry William Caird Esq. M.A., President, in the Chair.

The following Donation was announced :—

"Journal of the Society of Arts" Nos. 989 to 995—

*Presented by the Society.*

The following communication was read :—

On Foraminifera from the Tertiaries of San Fernando, Trinidad. By R. J. Lechmere Guppy F.L.S., F.G.S. &c.

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In July 1863 I brought under the notice of the Scientific Association the nature of the asphalt rock figured at page 38 of the Geological Report on Trinidad. I then stated that I had discovered that that rock consisted principally of the shells of Orbitoides and Nummulina, two genera of foraminifera characteristic of older and middle tertiary strata. In the interval between the reading and the printing of the paper in which my discovery was communicated to the Association, the same species of foraminifera had been detected in the miocene rocks of Jamaica, as noticed in a postscript to my paper. Previously however to this a few species of foraminifera had been recorded from the tertiaries of Haiti. The names of all these species

will be found in my paper on the Tertiary Fossils of the Westindies, printed in the Proceedings of the Scientific Association, 1867, page 145.

Owing to the nature of the cliffs at San Fernando great part of their face is often concealed for many years by earth fallen from the top, but occasionally the loose and disintegrated material is removed so as to expose the solid rock. This has happened lately to such an extent as to expose a large series of beds of which I had never previously been able to get a fair sight. These beds lie (in geological language) just above the nucula-rock which I have already described at pages 46 and 82 of the Proceedings for 1866 and 1867, and also in the "Geological Magazine," (vol. iv, p. 497). The mineral composition of these beds is argillaceous, with a large proportion of calcareous matter. Their color is of a light greenish-grey, and the effect of weathering upon the matter is to develope a sort of spheroidal concretionary structure entirely independent of the original bedding and lamination. This spheroidal structure is probably partly or wholly induced by meteoric action. The beds are an upward continuation of the nucula-bed, being similar in composition, and are part of the strata numbered 11 to 17 in the section given in my paper in the Journal of the Geological Society, vol. 22, p. 571; and I propose to term them the nodosaria-beds. They rarely contain any molluskan remains, but are stored abundantly with foraminifera characteristic of deep water. I append a list of the forms I have been able to determine, including those of the asphalte bed. These determinations are only approximate, and the geologist will not expect from me a very exact statement of

the varietal or subvarietal names of the forms, which can scarcely be given except by those who like Messrs. Parker and Rupert Jones have devoted great attention and study to these minute but beautiful shells. I trust however to place the material in the hands of those able to do more justice to the subject, and I only intend the present communication as a record and announcement of the discovery. So far as I am able to judge from the foraminifera now discovered, the facts appear to lend a further support to my view that the nucula-beds of Barbados and Trinidad were deposited in moderately deep water. The depth of water seems to have increased after the deposition of the nucula beds as seems to be evidenced by the nodosaria beds of Trinidad and the Polycystina beds of Barbados.

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*List of Foraminifera from the Lower Nuocene Strata of San Fernando, Trinidad.*

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Nummulina ramond *Defr.* var. } These three species are
Orbitoides mantelli *Norton* } only found in the asphalt
Amphistegina vulgaris *Orb.* } bed and gypseous marls.

Spiroloculina nitida *Orb.*

Glandulina laevigata *Orb.*

Nodosaria glabra *Orb.*

—— hispida *Orb.*

—— raphanistrum *Linn.*

—— ovicula *Orb.*

—— pyrula *Orb.*

Dentalina elegans *Orb.*

—— filiformis *Orb.*

—— communis *Orb.*

Orbulina universa *Orb.*

Globigerina bulloides *Orb.*

Polymorphina gibba *Orb.*

Rotalia orbicularis *Orb.*

—— corallinarum *Orb.*

Several other forms have not been satisfactorily determined.

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*Tuesday* 13*th February* 1872.

Henry William Caird Esq. M.A., President, in the Chair.

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*Tuesday* 12*th March* 1872.

Henry William Caird Esq. M.A., President, in the Chair.

The following Donations were announced :—

"Journal of the Society of Arts," Nos. 996 to 1004.—*Presented by the Society.*

"Correspondence between the Government of Jamaica and the Rev. Hugh Croskerry, M.D. relative to Small Sugar Mills," accompanied by a letter from the Rev. Dr. Croskerry, which was read to the meeting :—whereupon it was resolved that the Secretary be requested to convey the thanks of the Association to Dr. Croskerry for his communication on Small Sugar Mills and the Accidents arising from their use, and to intimate at the same time that the Association desires to express its hope that the philanthropical exertions of Dr. Croskerry will be attended with the beneficial results desired.

*Tuesday 9th April* 1872.

Henry William Caird Esq. M.A., President, in the Chair.

The following Donations were announced :—

"Semiweekly Gleaner" of Jamaica; No. .—*Presented by the Rev. Dr. Croskerry.*

"Journal of the Society of Arts"—Nos. 1005 to 1008.—*Presented by the Society.*

The following communications were read :—

1. A letter from the Chicago Academy of Sciences, respecting the losses sustained by them in the late Fire, and the desire of the Academy to receive donations of books and objects towards the re-establishment of their library and museum.

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2. *Third Series of* Additions *to the* Catalogue *of the* Land and Freshwater Molluska of Trinidad : *with a revised List of all the Species.*—By R. J. Lechmere Guppy. F.L.S., F.G.S., &c.

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In the first volume of the Proceedings of the Scientific Association, I have given a Catalogue of the land and freshwater molluska found in the island. Since the last additions made to this list, I have discovered several new species, some of which have been described : and acting upon the principle which the Association desires to be recognized, that all that is known of the natural productions of the island should be placed on record in its Proceedings, I now communicate the names of those species, together with descriptions of some previously undescribed.

As the correspondence which has arisen out of my previous publications on this subject has necessitated certain changes in nomenclature, I take the opportunity of appending a list of all the known species, with the names corrected according to the latest information I possess.

§ 1.—Descriptions of new Species.

*Gundlachia crepidulina.* n. sp.

Shell elongate-oval, slipper-shaped, horny: covered beneath by a whitish convex diaphragm, having a rounded or oval aperture at the anterior end; right side almost vertical, left side gently sloping.

In the American Journal of Conchology, 1870, p. 311, I described a shell under the name of *Ancylus textilis.* From certain characters given by me, my friend Mr. Thomas Bland suggested that this might be a *Gundlachia.* I have, since then, devoted some labor to the investigation of the subject, and although I have not succeeded in clearing up all the points of difficulty, I think that I am justified in describing both an *Ancylus* and a *Gundlachia* as inhabitants of our fresh waters. I have found additional examples of both forms. For the present, therefore, the name *Ancylus textilis* may be reserved for the shells agreeing with the specific description given in the American Journal of Conchology, and with the figure 9 of plate 17 therewith. To the *Gundlachia* figured under the number 11 on the same plate, and described here, the name of *crepidulina* may be attached. I have found no additional examples of the form represented in fig. 10 of the plate accompanying my paper in the American Journal of Conchology.

*Amphibulima (Omalonyx) felina* n. sp.

Animal almost smooth, of a slightly yellowish white, variegated with small spots, and streaked with two lines of cinereous purple extending from the two oculiferous tentacles to the point of the foot behind; mantle covering

the middle of the back, and reflected over a small horny shell, which it often completely covers, but is occasionally retracted, so as to expose the central portion : foot large, lanceolate, and coming somewhat abruptly to a point behind.

The pulmonary orifice is situated at the middle of the right side of the mantle. When fully expanded, the length of the largest example found was about 16 mill., and its breadth about 6 mill.

The shell is oval, wider anteriorly, of a pellucid horny texture, straw-colored, distinctly concentrically striate, with microscopic radiating lines; the edges are sharp and scarcely interrupted by a small notch at the junction of the right and left margins; the spire is small and somewhat prominent. The shell of the largest specimen was 9 mill. long and 5 mill broad.

The species belongs to the section *Omalonyx*, and is closely allied to *O. unguis* Fér.

When describing *Amphibulima pardalina* in my paper on the shells of Dominica (Ann. & Mag. Nat. Hist., June 1868), I pointed out the necessity for a separation of the genus *Amphibulima* from *Succinea*, in which some authors had located the species, and of regarding *Omalonyx* and *Brachyspira** as sections or subgenera of *Amphibulima*. My views on this head seem to have been anticipated by d'Orbigny, who, in his description of *Omalonyx gayana*, refers to *Amphibulima patula*, evidently regarding the two as congeneric, according to our present views of genera.

* But some of the species included under the head of *Brachyspira* in Alber's Die Heliceen are true Succineæ, e.g. the North American *S. effusa* and *S. salleana*.

In the genus *Amphibulima* the animal is incapable of retraction into its shell, and the latter is entirely, or almost entirely covered by the mantle. These characters do not obtain in Succinea. Distinctions of less importance than these are considered sufficient for the establishment of undoubted genera; and a glance at the shells will show that they cannot be ranked with *Succinea*.

I have been favored by Governor Rawson, C.B., with a specimen of *Omalonyx unguis* Fér. from Guadelupe. That shell is faithfully represented in Woodward's Manual of the Molluska (pl. xii., f. 24), and it scarcely differs from the Trinidad form. I do not know the soft parts of the Guadelupe mollusk: but it appears to me that a question here arises—the soft parts of *O. unguis*, as figured by d'Orbigny, are different from the Trinidad mollusk. D'Orbigny's animal was from South America, but Férussac's type appears to have been the Guadelupe shell It may then possibly turn out that d'Orbigny's species is not the same as Férussac's. Should the latter prove to be identical with the Trinidad shell, the name given by me must be abandoned, and a new appellation given to d'Orbigny's; but it is not improbable that all three are really distinct; for in a group like *Omalonyx*, where the shells are rather deficient in very marked characters, it may easily be that the specific differences are not so distinctly impressed upon the shell as upon the soft parts.

When recording my discovery of *Amphibulima patula* in Dominica, I gave no description of the animal, believing it already well-known to naturalists. At present I can only say that in general features it bears a resemblance to *Omalonyx unguis* as figured by d'Orbigny (Voy. Amer.

Merid. Mollusques, pl. 22, f. 1–7). It is, however, much larger, darker, and more strongly marked with brown and orange, and the granular reticulations of the surface are much coarser.

*Amphibulima felina* inhabits similar stations to *Amph. unguis*, viz., the stems and leaves of submerged plants. It cannot survive long if plunged into water, nor can it live if removed from the neighborhood of that element. I have found it near the head of the Maraval river only.

*Cyclas incurva* n. sp.

Shell oval, transverse, inequilateral, regularly and distinctly concentrically striate, generally marked with irregular black dots, usually rather high posteriorly; valves rather ventricose, with a broad round carina running from the umbo towards the posterior angle; umbones prominent, rather approximate, hinge line nearly straight—length 6 mill., height 5 mill., thickness 3 mill.

This species appears to be very distinct from any hitherto described, and in form it is not unlike an Anodon. Old specimens are nearly black, and have the umbones eroded. Compared with the only other known Trinidad species of the genus, this is much larger and thicker; it is also more oval and longer in proportion to its height, and the black markings also distinguish it from *C. punctifera*, which, according to Temple Prime, is a *Pisidium*. Of the latter shell I have lately acquired specimens identical in appearance with the type, but almost or quite destitute of the points from which the name is derived.

*Cyclas incurva* was found in the Chatham River at Erin, on the South Coast of Trinidad—but I have received examples of a shell without name, from M. Adolphe Schramm of Guadelupe, which I am not able to distinguish from ours.

## § 2.—Revised List of the Land and Freshwater Molluska of Trinidad.

N. B.—Where the species has been described in the first volume of the Proceedings no reference is deemed requisite.

A.N.H means Annals and Magazine of Natural History.
A.J.C. „ American Journal of Conchology.
P.S.A. „ Proceedings of the Scientific Association of Trinidad, vol i.

| Corrected Name. | Synonyms, &c. |
|---|---|
| Glandina Schumacher 1817 | |
| *minutissima* Guppy | Allied probably to Achatina iota, Adams. |
| Spiraxis Adams 1850 | |
| *simplex* Guppy | Tornatellina costellosa was described from an immature form of this shell. |
| Stenogyra Shuttleworth 1850 | |
| *octona* Chemn | |
| *caracasensis* Reeve | |
| *coronata* Guppy | (Melaniella). Only one specimen found. |
| *plicatella* Guppy | According to Bland two species (St. subula and St. octonoides) are included in this. |
| Cionella Jeffreys 1829 | |
| *lamellata* Pot. & Mich. | Tornatellina lamellata, P. & M. Leptinaria blandiana, Pf. |
| Zonites Montfort 1810 | |
| *guildingi* Bland | ? Stenopus cruentatus ? Guild. |
| *implicans* Guppy | |
| *umbratilis* Guppy | |
| Guppya Mörch 1867 | |
| *vacans* Guppy | See A.N.H. 4 ser. vol. i., p. 435, and A.J.C. vol. iv, part 4 (1868) ? Stenopus lividus, Guild. |
| Hyalina Fér. | |
| *alicea* Guppy | A.J.C. 1870, p. 309. |

| Corrected Name. | Synonyms, &c. |
|---|---|
| Helix Linné 1758 | |
| *bactricola* Guppy | See A.J.C. 1870, p. 307. |
| *ierensis* Guppy | ibidem. |
| *caeca* Guppy | ibidem. |
| Bulimus Scopoli 1777 | |
| *oblongus* Müll. | |
| *aurissciuri* Guppy | (Plekocheilus.) |
| Orthalicus Beck 1837 | |
| *undatus* Brug. | Bulimus zebra, P S.A., p. 16. |
| Bulimulus Leach 1814 | |
| *multifasciatus* Lam. | See A.J.C., vol. iv, part 4 (1868.) |
| *aureolus* Guppy | See A.J.C. 1870, p. 307. |
| var. *fasciatus* | |
| var. *albescens* | |
| var. *imperfectus* | B. multifasciatus *var.*, A.N.H. vol. 17 (3 ser.) p. 49. |
| *vincentinus* Pfeiff. | B. multifasciatus, P.S.A. p. 17 (partly.) |
| var. *citrinus* | B. immaculatus, P.S.A. p. 18. |
| *tenuissimus* Fér. | |
| *? fraterculus* Fér. | |
| ? Buliminus Ehrenberg 1831 | |
| *pilosus* Guppy | A.J.C. 1870, p. 310. |
| Autonoe Guppy 1868 | |
| *riparia* Guppy | Comp. Auricula pellucens. |
| Cylindrella Pfeiffer 1840 | |
| *trinitaria* Pf. | |
| Pupa Draparnaud 1805 | |
| *uvulifera* Guppy | |
| *auriformis* Guppy | Only a single specimen found |
| *eyriesi* Drouët | (Vertigo ) |
| *bicolor* Hutton | (Ennea.) |
| Streptaxis Gray 1837 | |
| *deformis* Fér. | |
| Simpulopsis Beck 1837 | |
| *corrugatus* Guppy | |
| Succinea Draparnaud 1801 | |
| *approximans* Shuttl. | This determination is doubtful. |
| Amphibulima Blainville 1825 | |
| *felina* Guppy | (Omalonyx.) |

| Corrected Name. | Synonyms, &c. |
|---|---|
| Veronicella Blainville 1817 | |
| *laevis* Fér. | |
| Melampus Montfort 1810 | |
| *coffea* Linn. | |
| *pusillus* Gmel. | (Tralia.) |
| Pedipes Férussac 1821 | |
| *mirabilis* Megerle | |
| Planorbis Geoffroy 1767 | |
| *terverianus* Orb. | P. terversanus P.S.A. p. 27. |
| *meniscus* Guppy | A.J.C. 1870, p 310. Allied to P. haldemani, Adams (Jamaica), but distinguished easily by its spire being more sunk. |
| Ancylus Geoffroy 1767 | |
| *textilis* Guppy | A.J.C. 1870, p. 311. |
| Gundlachia Pfeiffer 1849 | |
| *crepidulina* Guppy | |
| Physa Draparnaud 1801 | |
| *rivalis* Mat. & Rack. | P. soverbiana, Orb. |
| Amnicola Gould 1839 | |
| *spiralis* Guppy | Paludestrina spiralis, P.S.A p. 34. Allied to Amn. candeana, Orb. Cuba and Jamaica. |
| Marisa Gray 1824 | |
| *cornuarietis* Linn. | M. knorri, Phil., Ceratodes fasciatus, Guild. |
| var. *swifti* | |
| Ampullaria Lamarck 1789 | |
| *urceus* Müll. | |
| *effusa* Müll. | |
| var. *conica* | ? = Amp. crocostoma, Phil. |
| var. *tristis* | ? = do. var. |
| Cyclotus Guilding 1849 | |
| *translucidus* Sow. | *var.* Trinitensis |
| *grenadensis* Shuttl. | *var.* rugatus = C. rugatus, P.S.A. p. 30. |
| Diplomatina Benson 1849 | |
| *huttoni* Pfeiff. | *var.* occidentale. See A.N.H., 3 ser., vol. 20, p. 95 and 4 ser. vol. 1, p. 110—also A.J.C. 1870, p. 308. |

| Corrected Name. | Synonyms, &c. |
|---|---|
| Truncatella Risso 1813 | |
| *reclusa* Guppy | Blandiella reclusa A.J.C. 1870, p. 309. (Tabeitia.) |
| *pulchella* Pfeiff. | |
| Cistula Gray 1850 | |
| *aripensis* Guppy | (? Chondropoma.) |
| Helicina Lamarck 1822 | |
| *barbata* Guppy | H. dysoni? *var.* |
| *nemoralis* Guppy | |
| *ignicoma* Guppy | |
| *lamellosa* Guppy | (Perenna.) |
| Neritina Lamarck 1809 | |
| *microstoma* Orb. | |
| *viridis* Linn. | Marine species. |
| *meleagris* Linn. | idem. |
| Cyclas Bruguieres 1792 | |
| *punctifera* Guppy | (Pisidium.) |
| *incurva* Guppy | (? idem.) |
| Anodon Cuvier 1798 | |
| *leotaudi* Guppy | |

*Tuesday 9th July* 1872.

Henry William Caird Esq. M.A., President, in the Chair.

The following Donations were announced :—

"Journal of the Society of Arts"—Nos. 1009 to 1021.—*Presented by the Society.*

The following obituary notices were read :—

OBITUARY NOTICE OF HENRY F. J. GUPPY Ph. D., F.A.S.L.

Every member present this evening must have heard of the death of the gentleman who for the last seven years filled the post of Secretary and Treasurer to the Association.

I now communicate to you a notice of this sad event in order that a record of it may appear in due course in the Proceedings.

Henry Francis Jeune Guppy was born in England in 1839, and upon the completion of his education he came to Trinidad to join his family. Shortly after his arrival he received an appointment in the public Treasury of the island, in which office he remained until his death. Early in the present year he was appointed acting Subreceiver at San Fernando where he died on the 14th May last. In 1865 he undertook the compilation of a book-almanack for Trinidad, and as the merits of that publication, which has been regularly issued for seven years, are well known to all of you, constituting as it does a handbook of reference for all residents here, and for every one interested in the island, I need not dwell upon it. I am glad however to learn that its publication will be kept up.

Dr. Henry Guppy was elected Secretary of this Association in 1865, and with trifling intermissions he continued to act in that capacity until his removal to Sanfernando. In 1865 he communicated to us a paper entitled "Notes on the consumption of Spirituous Liquors in Trinidad," which is printed in our Proceedings. He was a fellow of the Anthropological Society of London.

In concluding this notice of a member whose death is so deeply regretted I may be allowed to pay a tribute to his high character. In private life he won the sincere esteem of all who knew him. His generous and kindly heart endeared him to every one—and the high encomiums he gained from the gentlemen who have from time to time been at the head of his department are testimony that he discharged his duties with faithfulness to the Government and with satisfaction to the public.

## Obituary Notice of Robert Swift, Corresponding Member.

I have also to announce to you the death of Mr. Robert Swift of St. Thomas, corresponding member of this Association. Mr. Swift was established as a merchant at St. Thomas, and during his long residence there he devoted much time and attention te the study of the Molluska. He formed a large and fine collection of shells, and it is understood that the collection will be acquired by the Academy of Natural Sciences in Philadelphia. He had been in failing health for some years past—and on his retirement from business he took up his residence in Philadelphia, but finding the climate too trying for him, he returned to St. Thomas.

## Contributions towards a Bibliography of Trinidad.

### Part II.

The Compilers of this Bibliography hoped that upon the appearance of the First Part (which was published in the Proceedings of the Scientific Association, part I, p. 48) members and others having access to publications referring to Trinidad would have furnished notices of such works. In this hope they were disappointed—and they have received no aid whatever in their labors. On this account indulgence is asked, first, for the long delay in the publication of the Second Part, and in the next place, for its incompleteness. Notwithstanding these drawbacks, there can be little doubt of the utility of the com-

pilation to all interested in the island, its history and progress.

It has not been deemed necessary in this part to give the titles of the articles published in the proceedings of the Scientific Association.

It is proposed to compile for publication a Third Part out of such information as may come to hand respecting books and papers not noticed in the First and Second Parts of the Bibliography. [R. J. L. G. and H. F. J. G.]

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Bland (Thomas, F. G. S.) Notes on the Land shells of Trinidad, Grenada and Dominica, and also of Curaçoa and Buenayre, W.I.—American Journal of Conchology vol. iv, part 4, 1868.

Capadose (Lieut. Col. )

Sixteen years in the Westindies—8vo. London 1845. 2 vols.—vol. i, pp. 1—173—vol. ii, appendices.

An account of journies through the island. On the 15th May 1839 the author arrived at Port-of-Spain from Tobago. At p. 124 he has the following:—"Who that ever passed a night at Sanfernando has not been aroused from their morning slumbers by the yells of the monkeys in the wood, or in the evening been startled by swarms of fire-flies darting through the palm trees." Of Portofspain he says "At one period this city boasted three theatres and five companies: one English and one French professional company, and three amateur societies." At p. 31 is mentioned the discovery of coal at Point Galeota.

The population of Trinidad is given (for 1838) at 39,328, of whom 19,250 were males and 20,078 were females. The population of Port-of-Spain was 11,698, of whom 4,912 were males and 6,716 females.

In 1841 there were 180 sugar estates. The following is a statement of the acreage in crops &c. :

| | | | |
|---|---|---|---|
| Canes | 21,710 acres | Provisions | 6,313 acres |
| Cacao | 6,910 ,, | Pasture | 7,237 ,, |
| Coffee | 1,095 ,, | | |
| | | Total in cultivation | 43,265 ,, |
| | | Total alienated | 208,379 ,, |

COLERIDGE (H. N.) Six Months in the Westindies—8vo. London 1825.

CRÜGER (HERMANN)

Einige Beiträge z. Kenntniss von sogennanten anomalen Holzbildungen des Dicotylen stammes—Botanische Zeitung, 1850 and 1851.

CRÜGER (HERMANN)

Westindische Fragmente. Botanische Zeitung 1857, p. 281—On the structure of the siliceous bark of a *Moquilea (Caraipa angustifolia)* called Cauto or Cauta—Also at p. 298, on the wood of the same. The remarkable siliceous bark (el cauto) of this (?) tree is fully described by Crüger.—See also H. von Mohl, Bot. Zeit. 1861, p. 211 and Wiche, p. 97.

CRÜGER (H.) Einiges ueber die Gewebsveränderungen bei der Fortpflanzung durch Stecklinge.—Bot. Zeit. 1860, pp. 369—374—1 pl.

CRÜGER. The Fibres of Trinidad—Technologist, vol. ii, p. 418—July 1862.

DUNCAN (Peter Martin, M.B., F.G.S.)

On the Fossil Corals of the Westindies—Part iv, Conclusion. Quarterly Journal of the Geological Society, vol. xxiv, p. 9.

Contains a description of the fossil corals collected by Mr. Eckel from the St. Croix beds, Naparima, Trinidad.

Gill (Theodore)

Synopsis of the Freshwater Fishes of the Western Portion of the Island of Trinidad. Annals of the Lyceum of Natural History of New York, vol. vi, 1858. Also published separately.

Mr. Gill describes the following species:

Polycentrus tricolor *Gill*
Ctenogobius fasciatus *Gill*
Cychlasoma pulchrum *Gill*
—— taenia *Bennett*
Crenicichla frenata *Gill*
Pimelonotus vilsoni *Gill*
Callichthys kneri *Gill*
Hoplosternum laevigatum *Val.*
—— stevardi *Gill*
Hoplosoma aeneum *Gill*
Corynopoma rüsei *Gill*
—— vsedoni *Gill*
Hypostomus robini *Val.*
Anchistrus guacharote *Val.*
Macrodon ferox *Gill*
Erythrinus cinereus *Gill*
Poecilurichthys brevoorti *Gill*
—— taeniurus *Gill*
—— pulcher *Gill*
—— unilineatus *Gill*
Curimatus argenteus *Gill*
Stevardia albipinnis *Gill*
Nematopoma searlesi *Gill*

See Prof. Agassiz to Dr. Leotaud, Proc. Scientific Association, part III, p. 179.

Greenwood (G. W.) Trinidad Handbook of Every Day Law—containing a variety of legal information connected with every-day life explained in a familiar manner—pp. 67. 8vo. Portofspain, 1867.

Guppy (Robert John Lechmere, F.L.S., F.G.S.) Notes on Westindian Geology, with remarks on the existence of an Atlantis in the early tertiary period, and descriptions of some new Fossils from the Caribean Miocene.—Geological Magazine—vol. iv—No. 11, November 1867.

Guppy (R. J. L.) Notes on some new Forms of Terrestrial and Fluviatile Molluska found in Trinidad.—American Journal of Conchology 1871, p. 306.

Guppy (R. J. L.) On the Terrestrial Molluska of Dominica and Grenada, with an Account of some new Species from Trinidad.—Ann. & Mag. Natural History, June 1868.

Guppy (R. J. L.) On the Discovery of Organic Remains in the Caribean Series of Trinidad.—Quarterly Journal of the Geological Society, vol. xxvi—1870—p. 413.

Halliday (Sir Andrew, K.H., M.D., F.R.S.E., Deputy Inspector-General of Army Hospitals).

The Westindies: the natural and physical history of the Windward and Leeward Colonies, with some account of the moral, social and political condition of their inhabitants immediately before and after the abolition of negro slavery.—Pp. 286—378.

Kingsley (Charles). Letters from the Tropics—in "Good Words" for 1870—pp. 202–211, 238-245, 308–319, 380–391, 499–511, 569–584, 649–656, 720–728, 817–830.—London 1870.

A series of letters for the most part containing highly colored sketches of scenery and life in Trinidad.

Kingsley (Charles). At Last—1 vol. 8vo. London 1872 (new edition).

In this work the Revd. Canon gives a more full account of his visit to Trinidad. In addition to the matter contained in his Letters from the Tropics comments are inserted on various subjects of local interest—but the roseate

medium through which the author saw everything during his sojourn in Trinidad has detracted from that accuracy and impartiality so desirable in treating of places and politics, men and manners.

LEDRU (André-Pierre).

Voyage aux isles de Teneriffe, la Trinité, St. Thomas, Ste. Croix et Porto Rico executé par ordre du Gouvernement français depuis le 30 Sept. 1796 jusqu'au 7 Juin 1798, pour faire des recherches et des collections relatives à l'histoire naturelle—Avec notes par M. Sonnini.—2 vols. Paris 1810—8vo.—Vol. I, pp. 232–311.

The author of this work was a botanist who accompanied the expedition. After visiting Teneriffe they proceeded to Trinidad. They entered the Gulf of Paria by the Serpent's Mouth where they observed a battle between a whale (Balaena physalus L.) and a *scie* (saw-fish, Squalus pristis L.). During their voyage the island had fallen into the possession of the English. They had however a safe-conduct from the British Admiralty, but were not allowed to remain more than eight days. The author speaks (p. 235) of the numerous corsairs to be met with in the Gulf. M. Sonnini (at p. 245) furnishes a note on the Pelican. Chapter xvi treats of the population, cultivation, products and natural history of Trinidad and the Gulf. The population of St. Joseph is stated at 1900 or 2000. The author quotes McCallum, also a paper on the Pitch Lake in the Transactions of the Linnean Society for 1789 vol viii, and another paper on the same subject by Dr. Anderson in the Philosophical Transactions for the same year.

*List of Animals recorded as having been found in Trinidad.*

*Mammals.*

Simia semiculus *Gmel.*
Tiger Cat
Une espèce de Biche
Didelphys philander *Gmel.*
Hystrix cristata *Dand.*
Lamantin (Manatus australis *Gmel.*)
Cavia americana *Gmel.*
Mus pilorides *Gmel.*
Cavia paca *Linn.*
Dasypus novemcinctus *Gmel.*
Bradypus didactylus *Dand.*
Mustela lutris
var. brasiliensis *Gmel.*

*Birds.*

Pelecanus fuscus *Gmel.*
Anas dominica *Gmel.*
Pelecanus aquilas *Gmel.*
Charadrias pluvialis *Gmel.*
Falco nudicollis
Ara aracanga *Dand.*
Picus bengalensis *Dand.*
—— carolinus *Dand.*
Strix flammea *Buff.*
Hirundo cayennensis *Buff.*
Pipra rupicola *Buff.*
Trogon curucin *Gmel.*
Trochilus viridissimus *Gmel.*
—— tobaci *Gmel.*
Tanagra choloroica *Gmel.*
Colymbis dominica *Gmel.*
Fulica cayennensis *Gmel.*
Ardea gazetta *Gmel.*
Pelecanus ruta *Gmel.*
Strix phalenoides
Psittacus alexandri *Dand.*
—— dominicensis *Dand.*
Vultur papa *Dand.*
—— aura *Dand.*
Psittacus guarouba *Gmel.*
—— ochrocephalus *Gmel.*
—— aestivus *Gmel.*
—— melanocephalus *Gmel.*
Turdus aurantius *Gmel.*

*Insects.*

Cassida taurus *Fabr.*
Melolontha rustica *Fabr.*
Apalus ruficornis *Latr.*
Hygaeus varicolor *Fabr.*
Formica tuberculata
Horia maculata *Fabr.*
Apis haemorrhoides *Fabr.*
—— cordata *L.*
—— dentata *L.*
Vespa americana *Fabr.*
Fulgur phosphorea *L.*

McCallum (Pierre F.)

Travels in Trinidad during the Months of February, March and April 1803. Vol. 8vo. Liverpool 1805. 354 pp.

This work is mainly a tirade against General Picton who was Governor of Trinidad at the time of McCallum's visit. An imperfect account of the island and some of its productions is contained in the book.

Mallet (F.)

Descriptive Account of the island of Trinidad made by order of Sir Ralph Abercrombie K.B. 1797, with map and tables—4to. London 1802—15 pp.

This contains a brief description of the physical features of the island and of its productions and also of those of parts of the adjoining continent.

*Population July* 1797.

| | *Whites.* | *Colored.* | *Slaves.* | *Indians.* | *Total.* |
|---|---|---|---|---|---|
| Males .. .. | 1295 | 2094 | 5396 | 495 | 9280 |
| Females .. .. | 856 | 2382 | 4613 | 587 | 8438 |
| Total .. | 2151 | 4476 | 10,009 | 1082 | 17,718 |

Mention is made in this work of the lamentin or manati weighing generally from 5 to 8 cwt. or more, and of the pantouflier or zigene, a dangerous and voracious monster, 10 or 12 feet long and thick in proportion; its head is shaped like a hammer having large round terrific eyes, a wide mouth well armed with teeth, and more conveniently disposed for biting than those of the shark, to which in many respects this animal bears much resemblance. Notice is taken of two gulfs or vortices in the sea, one near Labrea, which in stormy weather gushes out, raising the water five or six feet and covering its surface with petro-

leum or tar: the other, in the Bay of Mayaro, in the months of March and June produces a detonation like thunder, having some flame with a thick black smoke, which vanishes immediately; and in 24 hours afterwards a quantity of bitumen is found along the shore. The author quotes Alcedo (Dict. of W. I. and America) as being the only Spanish author who has given any details concerning Trinidad.

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MORTON (J. )

On the Pitch Lake of Trinidad. Proceedings of the Novascotian Institute of Natural Science, vol. i—part iv, p. 66 (1866).

MANROSS ( )

On the Pitch Lake of Trinidad. American Journal of Science and Arts—September 1855.

TAYLOR (E. Cavendish, M.A., F.L.S.)

Five months in the Westindies. Part I, Trinidad and Venezuela. Ibis, vol. vi, No. 21, January 1864, pp. 73–97.

Contains a list of the birds of Trinidad collected or observed by the author.

THOMAS (JOHN JACOB) The Theory and Practice of Creole Grammar—8vo. Portofspain 1869. pp. 135.

A very interesting and complete account of the patois French spoken in Trinidad. At the end are some idiomatic expressions, proverbs and translations, and the work is not only a curious but a valuable addition to our literature.

[Tronchin (Louis Bernard)] Les Mysterès de l'ile aux Colibris—par un Creole—Premiere Partie—"L'oncle et le neveu"—Portofspain 1865. 8vo. pp. 31. The same—Deuxieme partie—"Les Nègres Marrons"—Portofspain, 1866—8vo, pp. 44.

As stated in the Preface this work was originally intended to consist of six parts, of which however only the above two have been issued. It is a work of fiction, of which the scene is laid in Trinidad, twenty to thirty years before emancipation.

TRINIDAD MONTHLY MAGAZINE. 8vo. Portofspain 1871–2. (Only three parts published).

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## Notices of Memoirs.

### *On the* Geology *of the* Northern Westindia Islands. *By* P. T. Cleve.

Mr. P. T. Cleve has presented to the Royal Swedish Academy of Sciences a memoir on the Geology of the North-eastern Westindia Islands. This communication treats only of the geology and the minerology of the Islands in questton; the paleontology being reserved for a future paper; but there are notices of some of the fossils observed by the author, who also gives a summary of the geology of the other parts of the Westindies, as far as it is known from publications.

The author gives detailed accounts of the geology of the islands visited by him, namely the Virgin Islands, Portorico, Santacruz and the Leeward islands. He has observed a great variety of formations in these islands, in which the hypogene and volcanic rocks appear in great force. Of the series of formations the relative age of which is ascertainable by organic remains we have the miocene in Anguilla and probably in some of the other islands. In St. Barts the author discovered limestone with fossils resembling those of the Sanfernando beds in Trinidad, which he regards with considerable probability as being of eocene age, its characteristic echinoderm being *Echinolampus ovumserpentis* Guppy (that of the miocene of Anguilla being *E. lycopersicus* Guppy). The cretaceous

formation is found in St. Thomas and others of the Virgin islands. It is characterized by shells of the genera *Acteonella, Ammonites, Nerinea* &c.

Mr. Cleve doubts whether the paleozoic *Favosites* said to have been found at St. Thomas and described by Duchassaing and Michelotti is really a production of that island, where he found no fossils of paleozoic appearance. Metamorphic rocks which may however be paleozoic are developed in the Virgin islands.

The paper under notice contains a very full account of the rocks and minerals observed, and it is illustrated by geological maps of the islands visited by the author.

[R. J. L. G.]

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RULES *and* REGULATIONS *and* LIST *of* MEMBERS *of the* SCIENTIFIC ASSOCIATION *of* TRINIDAD—1872–73.

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*The object of this Association is the cultivation of Scientific Knowledge in the West Indies.*

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RULES:

1. This Association shall be called the "Scientific Association of Trinidad."

2. The objects of the Association shall be carried out by the reading of Papers and the discussion of Scientific subjects, by maintaining a correspondence with scientific men in other countries, by assisting in the development and application of Science in the West Indies, and generally by the collection and publication of useful information.

3. The Association shall consist of Members, Corresponding Members, and Honorary Members.

4. The Association shall, in October of each year, elect from among the Members a President, two Vice-Presidents, and a Secretary and Treasurer, who shall constitute the Council of the Association. Such Council shall have, subject to the Rules, the general management of the affairs of the Association.

5. The person who shall have filled the office of President in any year shall not be eligible for election as President for the next following year.

6. When any candidate shall be proposed for admission to the Association as a Member, he shall be balloted for at the next meeting thereafter, one black ball in five excluding.

7. The Association may elect as Corresponding Members such persons in the West Indies and elsewhere as from their services to Science are likely to contribute towards the advancement of the objects of the Association.

8. The Association may elect as Honorary Members such persons not permanently resident in Trinidad as may be desirable.

9. The Association shall meet on the second Tuesday in each month, or on such other day as may be fixed by the Council.

10. No motion relative to the Rules of the Association shall be brought forward except at a Special General Meeting of the Association; and no such motion shall be carried, except by a majority of at least two-thirds of the Members present at such Special General Meeting.

11. One-third at least of the Members of the Association actually in the Island shall be required to constitute a Special General Meeting: and in order to constitute such

Special General Meeting, it shall be requisite to give notice thereof at an ordinary Meeting.

12. Provided however that the ordinary meeting in October of each year shall have all the powers of a Special General Meeting without respect to the number of Members present.

13. The Subscription of each Member shall be Five Dollars per annum, payable on the first day of October. Every new Member on election shall pay the subscription for the current year.

14. No member whose subscription shall be in arrear for three calendar months, unless at the time absent from the Island, shall be entitled to any of the privileges of membership.

15. The Secretary shall, at the monthly meeting in February of each year, lay before the Association lists of those Members whose subscriptions are in arrear.

16. Members may introduce Strangers to the meetings. Provided that no person shall be considered a Stranger after he shall have been resident in the Island three calendar months.

17. Every Member shall be entitled to one copy of each Paper printed since his election.

18. No Member shall be entitled to receive free any paper published during any period for which he shall not have paid subscription.

19. The Author of every Paper printed for the Association shall be entitled to have six copies of such Paper.

20. Members desiring to obtain copies of the Proceedings of the Association, other than those to which they are entitled as specified in the preceding Rules, may have the

same, as far as copies are available, on payment of the following rates:

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*Members are requested to communicate changes of Residence, &c. to the Secretary.*

---

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# PROCEEDINGS

OF THE

# SCIENTIFIC ASSOCIATION

OF

# TRINIDAD.

**DECEMBER 1873.**

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# PROCEEDINGS

OF THE

# SCIENTIFIC ASSOCIATION

OF

# TRINIDAD.

PART X.] DECEMBER 1873. [VOL. II—No. 2.

*Tuesday*, 21*st January*, 1873.

H. W. Caird, Esq., M.A., President in the Chair.

The following donations were announced:

"Journal of the Society of Arts," Nos. 1022—1047. *Presented by the Society.*

W. R. Greg.—"Why are women redundant."—*Presented by R. J. L. Guppy.*

Three copies of "Tridaily Weather Map, and Bulletin." *From the Office of the Chief Signal Officer U. S. War Department, Washington.*

James John Day, Esq., F.C.S., and Arthur Francis Nixon, Esq., were elected members of the Association.

An obituary notice of the Hon. Richard Hill of Jamaica, a corresponding member of the Association, was read.

---

*Tuesday*, 15*th April*, 1873.

At the Laboratory—

H. W. Caird, Esq., M.A., President in the Chair.

The following donation was announced.—"Journal of the Society of Arts"—Nos. 1048—1060—*from the Society.*

The following communication was read :—

## *ON THE WESTINDIAN RISSOINAE.*

By Henry Krebs, *Corresponding Member.*

(ABRIDGED.)

---

The following thirty-one species of RISSOINA have been attributed to the Westindian Province :—

Rissoina affinis *Adams*
albida *Adams*
browniana *Orb.*
bryenea *Mont.*
cancellata *Phil.*
candida *Brown*
catesbyana *Orb.*
chesneli *Mich.*
decussata *Mont.*
dubiosa *Adams*
dunkeri *Phil.*
elegans *Orb.*
elegantissima *Orb.*
firmata *Adams*
fortis *Adams*
Rissoina janus *Adams*
laevigata *Adams*
laevissima *Adams*
multicostata *Adams*
philippiana *Pfeiff.*
princeps *Adams*
pulchra *Adams*
reticulata *Sow.*
sagraiana *Orb.*
scalarella *Adams*
scalariformis *Adams*
scalarioides *Adams*
sloaneana *Orb.*
striatocostata *Orb.*
striosa *Adams*
vitrea *Adams*

The genus has been treated with great care by Gustav Schwartz von Mohrenstern in his work "Ueber die Familie der Rissoiden und ins besonders die Gattung Rissoina" (Vienna 1860—11 plates). He divides the genus into the following groups :

Division I.—*Shell with broad longitudinal ribs and generally fine transverse lines.*

a. Without a protuberance on the neck.—No Westindian species belongs to this group.

b. With a protuberance on the neck.

1. *Rissoina elegantissima* Orb.

*D' Orbigny, Hist. Nat. Cuba, part* 2—p. 26 *pl.* xii.—f. 27—29. (1842).

*Schwartz von Mohrenstern, op. cit.* p. 50, f. 12

*Habitat*, Haiti, Cuba, Bahamas.

2. *Rissoina subangulata* Adams

*C. B. Adams, Contributions to Conchology, p.* 112, *S. v. M. op. cit.* p. 56, f. 20. [(1850).

3. *Rissoina scalariformis* Adams.

R, scalariformis *C. B. Adams, Catalogue of Shells collected at Panama* pp. 180, 314. (1852).

Idem S. v. M op. cit. p. 59, f. 24.

R. firmata (Adams) *P. P. Carpenter, Proc. Zool. Soc. London, vol.* p. 15 (1863).

*Habitat*, Panama, Mauritius, the Red Sea, St. Thomas (Westindies).

---

Division II.—*The shell with narrow longitudinal ribs without distinct transverse lines.*

a. With a distinct canal.

1. *Rissoina dubiosa* Adams.

*C. B. Adams in Contributions to Conchology*, p. 114 (1850).

*S. v. M.* op. cit. p. 67. f. 31, 31a.

A shell very like the fossil *R. grateloupi* Orb. and the recent *R. pusilla* Brocchi from Mauritius, the Sandwich Islands and perhaps the Mediterranean Sea. All three are perhaps varieties of the same species. It is found in collections in Germany under the name of *R. dunkeri* Pf.

*Habitat*, Cuba, St. Thomas, Jamaica.

b. Without a canal.

1. *Rissoina bryenea* Mont.

? Turbo costatus *Donovan, Brit. Shells*, p. 178, f. 3.
,, bryeneus, *Montagu, Test. Brit.* p. 313, tab. 15. f. 8.
Pyramis nitens, *Brown, Ill. Conch.* pl. 50, f. 77.
Cingula bryenea, *Fleming, Brit. Animals*, p. 307.
Turbo bryeneus, *Wood, Ind. Test.* p. 31, f. 102.
Rissoa bryenea, *Macgill., Moll. Aberd.* p. 341.
Nassa bryenea, *Brown, Ill. Conch.* p. 5 (fide *Forbes & Hanley, Brit. Moll.* iii, p. 149, part).
Rissoa lactea, *Brown, Ill. Conch.* p. 11, pl. 8, f. 77.
Rissoina scalarioides, *Adams, Philippi in der Zeitschr. für Malak.* 1848 p. 13.
Rissoa scalarioides, *C. B. Adams, Contrib. to Conch.* p. 113.
Rissoina bryenea, *S. v. M. op. cit.* p. 71, f. 36.

It is not unlikely that this species is identical with *Rissoina firmata* Adams, and *R. dubiosa* Adams. When young it approaches *R. chesneli* Mich., but the tooth-like elevation on the labrum supplies a distinctive character.

*Habitat.* Cuba, Jamaica, Virginislands, Martinique, Guadelupe, Mauritius.

2. *Rissoina firmata* Adams.

*C. B. Adams, Cat. Moll. Panama* pp. 177, 313.
*S. v. M. op. cit.* p. 72, f. 37.

Dr. Philip P. Carpenter in his "Review of Prof. C. B. Adams' Catalogue of the Shells of Panama from the Type Specimens" (Proc. Zool. Soc. Lond. 1863, p. 15) says, "it has a fine spiral sculpture," and that it is identical with *R. scalariformis* Adams. Prof. Adams found only one specimen at Panama, and Schwartz von Mohrenstern has

one specimen from Cuba. S. v. Mohrenstern takes it to be a variety only of *R. bryenea* Mont.

3. *Rissoina chesneli* Michaud.

R. chesneli, *Mich. Descript. des coquilles nouvelles*, p. 77.

R. catesbyana, *Orb. Hist. Nat. Cuba, part* 2, p. 24, pl. 2, f. 1—3.

R. candida *Brown, Ill. Conch.* p. 11, pl. 9, f. 75.

R. scalarella, *C. B. Adams, Proc. Bost. Soc. Nat. Hist.* vol. ii. p. 6.

R. chesneli, *S. v. M.* p. 73, f. 38, 39.

Professor C. B. Adams in his "Contributions to Conchology" (p. 113) remarks that *R. scalarella* is closely allied to *R scalarioides;* it has on each whorl 12 to 14 ribs which are larger than in *R. scalarioides:* and it has in large specimens the following dimensions: mean divergence about 24°, length of spire 0·1 inch, total length 0·155 inch, breadth 0·06 inch.

*Habitat.* Mauritius (?) Antilles, Bahamas, Mediterranean (?)

Division III.—*With very fine and closely set longitudinal lines.*

1. *Rissoina reticulata* Sowerby

*Genera of Shells*, pl. 208, f. 1.

*S. v. M. op. cit.* p. 74, f. 40.

Schwartz von Mohrenstern remarks that the *Rissoa reticulata* Phil. given as a synonym to *R. reticulata* Sow. by Reeve (Conch. Syst. p. 152) is a mistake arising from the similarity of the name; but the two shells are distinct species belonging to different genera. The same author mentions that *Rissoina princeps* Adams may not be the same, but it is closely allied to *R. decussata* Montague, *R.*

*striatocostata* Orb., *R. janus* Adams, *R. multicostata* Adams, and *R. striosa* Adams, amongst recent species, and to *R. obsoleta* Partsch, and *R. cochleanella* Lam. among fossil species. *Habitat*: Jamaica, Antilles (? Phillipines, Mauritius).

2. *Rissoina decussata* Montague.

Helix decussata, *Mont. Test. Brit.* p. 399.
Turbo ,, *Dillwyn, Recent Shells*, p. 882.
Rissoa cochleanella, *Basterot (part) Mém. géol. sur. Bordeaux*, p. 37.
Phasianella decussata, *Fleming, Brit. An.* p. 302.
Rissoa alata, *Menke, Synopsis*, p. 138.
,, striatula, *Andrzegowski, Bull. Soc. Géol. Franc* 1835, p. 321.
Rissoina striatocostata, *Orb., Moll. Cuba* vol. ii. p. 27, pl. xii, f. 30--32.
Rissoa pyramidella, *Brown, Ill. Conch. Great Britain*, p. 11 (probably).
,, costulina, *Sismonda, Syn. Meth.* p. 53.
,, striosa, *C. B. Adams, Contr. Conch.* p. 116.
Rissoina subcochleanella, *Orbigny, Prodrome, vol.* iii, p. 29.
Rissoa janus, *Adams, Cat. Panama*, p. 538.
Rissoina decussata, *Hoërnes, Foss. Moll. Wien.* p. 553, pl. 48, f. 1.
,, decussata, *S. v. M.* p. 81, f. 44, 44a.

Schwartz von Mohrenstern mentions the affinity of this species to *R. reticulata* Sow. and to the fossil *R. obsoleta* Partsch; and he states that the number of longitudinal ribs varies from 22 to 45: he thinks that the specimens with very fine ribs may be separated as a variety: to this would belong *R. striatocostata* Orb. and *R. janus* Adams;

in these the lines form a fine network; but in the specimens with the coarse longitudinal lines the spiral lines are only visible on the lower part of the last whorl. The longitudinal lines are often few on the upper whorls and increase in number on the lower ones; if decreasing on the lower whorls the spiral lines are very distinct. Such varieties are found both in the recent and the fossil shells. *Habitat:* Jamaica, Panama, Bahamas, Virgin Islands; Mediterranean, Mauritius, Eastern Seas. Fossil in Europe.

3. *Rissoina multicostata* Adams
   *C. B. Adams, Contr. Conch.* p. 114
   *S. v. M. op. cit.* p. 86, f. 48

*Habitat:* Cuba, Jamaica.

Division IV.—Cancellated.

1. *Rissoina bicollaris, S. v. M. op. cit. p.* 87 *f.* 50, nearest to *R. fenestrata* S. v. M., but the longitudinal ribs are more numerous and larger.

*Habitat:* Westindies.

2. *Rissoina fenestrata* Schwartz, S v. M. op. cit. p. 88, f. 51. Approaches *R. clathrata* Adams, but the aperture is narrower and straighter; the longitudinal ribs are straighter and the entire shell much smaller. *Habitat:* Cuba.

3. *Rissoina cancellata* Philippi.
   R. cancellata, *Phil., Malak. Zeitschr.* 1847, p. 127.
   — pulchra, *Adams, Contr. Conch.* p. 114.
   — philippiana, *Pfeiff.*
   — cancellata, *S. v. M. op. cit.* p. 89, f. 52.

*Habitat:* Westindies.

4. *Rissoina sagraiana* Orb.
   *Orb. Moll. Cuba,* pt. ii, p. 25, pl. xii, f. 4, 5.
   *S. v. M.* p. 90, f. 54.

Closely allied to *R. nitida*, Adams, Phillipines.

*Habitat:* Westindies.

5. *Rissoina labrosa* Schwartz.

*S. v. M. op. cit.* p. 94, f. 58.

Described from a single specimen.

Division V.—*The upper whorls only longitudinally lined, the lower whorls with fine spiral lines.*

1. *Rissoina albida* Adams.

R. albida, *Adams, Proc. Bost. Soc. N. H.* 1845, f. 6.

— affinis, *Adams, l. c.*

— albida, *S. v. M.*, op. cit. p. 103, f. 68.

*Habitat:* Jamaica, St. Thomas.

2. *Rissoina semiglabrata* Adams

*A. Adams Proc. Zool. Soc. Lond.* p. 279

*S. v. M. op. cit.* p. 103, f. 69.

*Habitat:* Cuba. One specimen only known from beneath a stone at low-water-mark.

Division VI.—*Smooth.*

a. *The embryo-whorls folded.*

All the species of this section are from the Eastindies and Pacific Ocean.

b. *Entirely smooth.*

1. *Rissoina browniana* Orb.

R. browniana, *Orbigny, Moll. Cuba*, pt. ii, p. 28, pl. xii, f. 33, 35.

— laevissima, *Adams, Contr. Conch.* p. 115.

— browniana, *S. v. M.*, op. cit. p. 110, f. 78.

*Habitat:* Westindies.

2. *Rissoina laevigata* Adams

*C. B. Adams, Contr. Conch.* p. 114

*S. v. M.* op. cit. p. iii, f. 79.

3. *Rissoina sloaneana* Orb.
*Orb. Moll. Cuba*, pt. ii, p. 28, pl. xii, f. 36, 38
*S. v. M. op. cit.* p. 112, f. 80.
*Habitat:* Westindies.

4. *Rissoina vitrea* Adams
*C. B. Adams Contr. Conch.*, p. 115
*S. v. M. op. cit.*, p. 113, f. 82.
*Habitat:* Jamaica.

---

With regard to the divisions adopted by Schwartz von Mohrenstern it seems that the division I is well founded; but we do not agree with this author in the opinion that the form of the protuberance is constant, and sufficient for the distinction of species. Division II we do not consider tenable. The species here included we should regard as another subdivision (c) of division I: *Shells with narrow longitudinal ribs, without distinct transverse lines, and a canal more or less distinct.* In the species grouped in Schwartz's subdivision *a* of division II the canal is not to be seen in young examples. On the other hand in old specimens of subdivision *b* of the same division the canal is *visible.* Schwartz admits that *R. dubiosa* Adams, which he places under *a* of his Division II, may be a variety of *R. bryenea* or *R. firmata*, both of which belong to section *b*. These divisions are therefore not tenable. The divisions III, IV, V, and VI are well characterized.

The thirty-one species enumerated above are reduced by Schwartz to the following 17:—

Rissoina albida *Adams* (= affinis *Adams*)
browniana *Orb.* (= laevissima *Ad.*)
bryenea *Mont.* (scalarioides *Ad.*)

cancellata *Phil.* (philippiana *Pf.* and pulchra *Ad.*)
chesneli *Mich.* (candida *Brown*, catesbyana *Orb.* and scalarella *Ad.*)
decussata *Mont.* (janus *Ad.* striatocostata *Orb.* and striosa *Ad.*)
dubiosa *Ad.* (dunkeri *Phil.*)
elegans *Orb.*
elegantissima *Orb.*
firmata *Adams*
fortis *Adams*
laevigata *Adams*
multicosta *Adams*
reticulata *Sow.* (? princeps *Ad.*)
sagraiana *Orb.*
scalariformis *Adams*
vitrea *Adams.*

He adds as appertaining to the Westindies *R. subangulata* Adams and *semiglabrata* Adams, and describes as new species : *R. labrosa, bicollaris,* and *fenestrata.*

The modest way in which this competent judge speaks of the opinions of other authors and in which he presents his views is very commendable, and he places before the student all the available materials to enable him to form a judgment upon the points under discussion.

Taking Schwartz von Mohrenstern's work as a basis, and examining a very large number of Westindian Rissoinæ we are inclined to reduce the species to the following 10 (or 8 ?)

1. Rissoina browniana *Orb.*
   R. laevissima *Adams*
   laevigata *Adams*
   sloaneana *Orb.*
   vitrea *Adams*

2. ,, bryenea *Montague*
   R. candida *Brown*
   catesbyana *Orb.*
   chesneli *Mich.*
   dubiosa *Adams*
   firmata *Adams*
   pusilla *Brocchi*
   scalarella *Adams*
   scalarioides *Adams*
3. ,, cancellata *Phil.*
   R. bicollaris *Schwartz*
   fenestrata *Schwartz*
   labrosa *Schwartz*
   philippiana *Pf.*
   pulchra *Adams*
   sagraiana *Orb.*
4. ,, decussata *Montague*
   R. albida *Adams*
   affinis *Adams*
   janus *Adams*
   striatocostata *Orb.*
   striosa *Adams*
5. ,, elegantissima *Orb.*
6. ,, firmata *Adams*
   R. scalariformis *Adams*
   (?) subangulata *Adams*
7. ,, multicostata *Adams*
8. ,, princeps *Adams* (perhaps a form of *R. reticulata* Sow.)
9. ,, reticulata *Sow.*
10. ,, subangulata *Adams* (see No. 6).

*R. elegans* Orb. is not a Westindian species, but a fossil from Dax in France.

Mr. Lechmere Guppy observed on the foregoing paper that the alliances pointed out by the author between recent Westindian shells and European miocene fossils were worthy of notice in connection with the theory of the Tertiary Atlantis. He had not noticed any Rissoidae in the Westindian miocene; but he thought that if such were found they might probably lend support to that hypothesis. The species particularly noticed by Mr. Krebs as being allied were the following:—

*R. decussata* Mont. fossil at Vienna, and also allied to *R. obsoleta* Partch.

*R. reticulata* Sow. allied to *R. cochleanella* Lam. and also to *R. obsoleta* Partch, both European Miocene Fossils. It might be doubted if the distribution of the species were really in all cases as wide as indicated in the paper: for he did not think that more than a very few among known shells were common to the East and Westindies. He should like the Rissoinae alleged to be common to those regions to be carefully examined and compared before being pronounced identical. If such identity be established it is scarcely less interesting than the alliances between the recent and fossil faunas; and the identity may be accounted for on the same grounds, namely the migration eastward during the early and middle tertiary period of the Westindian marine fauna. Mr. Guppy further inclined to the opinion that the revised and expurgated list of Westindian Rissoinae given by Mr. Krebs at the end of his paper might be regarded as fairly correct. All the known forms of Westindian Rissoinae could be placed under one or another of the eight (or ten) names included in the list.

Mr. Day was elected to act as Secretary of the Association for the ensuing year.

J. J. Bowry, Esq. F.C.S. and Professor H. E. Armstrong Ph. D. F.C.S, were elected Corresponding Members of the Association.

---

*Tuesday, May 13th,* 1873.

The ordinary meeting was held at the Laboratory.

---

*Tuesday June 10th,* 1873.

H. W Caird Esq., M.A., President in the Chair.

The following donation was announced :

"Journal of the Society of Arts," Nos. 1061—1065—*from the Society.*

A letter was read from the Honorable the Colonial Secretary granting permission for the meetings of the Association to be held in the Laboratory.

The following communication was read—

ON THE PRODUCTION OF GUTTA PERCHA FROM THE JUICE OF THE BALATA TREE.

By J. J. Day, F.C.S.

---

Soon after my arrival in this colony my attention was drawn to the fact that many of the common forest trees native to the Island yielded a juice or sap that by proper treatment can be converted into a valuable article of commerce. Amongst these I found the Balata preëminent. The tree known in Trinidad as the Balata very closely resembles in all its properties the "Bullet" or "Bully" Tree of Demerara, but I believe differs from that tree in that it bears a larger fruit. This tree exists in large numbers on the north and east coast of Trinidad and also is scattered about in the forests in all parts of the Is-

land. It varies in size very greatly and sometimes reaches 30 to 36 inches in diameter and rises to a height sometimes amounting to 50 or 55 feet below the branches. The milk or sap obtained from this tree has the appearance and consistency of thick cream and when fresh is almost without smell and has no action whatever on test paper. On keeping for some time it acquires a sour smell, changes color, gradually becoming brown, and has a strongly acid reaction. The formation of this acid is most likely due to the oxidizing action of the air, as a sample of the juice kept hermetically sealed in a bottle for some months did not exhibit any change.

To obtain the juice from the tree we have two processes. The first is by simply tapping the standing tree. This is done by the workman making a number of diagonal cuts in the bark, the cuts being made from left to right and reversely alternately, so that they meet at a point; the bark between the two cuts is then slightly raised. This cutting is continued as high as the workman can reach and consequently only saves a very small proportion of the juice of the whole tree. The juice runs out from each cut and is carried either by means of a fresh leaf or of a slip of copper into the wooden vessel placed to receive it. By this method of tapping, a tree has rarely been known to yield more than 3 lbs of the dried gum, more often yielding between 1 and 3 lbs. The other method by which the milk can be obtained is by felling the tree and cutting annular incisions in the bark about every 15 inches and placing under each incision a wooden vessel to collect the juice as it runs out. By this method a far larger quantity of the juice can be obtained from each tree; an average good sized tree will yield 20 lbs of

the dried gum and one tree I had tapped in this way yielded me 50 lbs. Even by this method however, less than one half of the juice is saved as it is impossible to tap the small branches &c. However by stripping the bark from the branches and submitting it to pressure between rollers we can obtain almost the entire amount. The juice obtained by pressure is much less pure than that obtained by tapping the tree, on account of the large quantity of water and mineral impurities that are also expressed from the bark. The juice as it leaves the tree contains from 40—50 per cent. of water, and the problem is how to get rid of this water most readily and economically and at the same time to leave the gum in a pure condition. The readiest and by far the cheapest method is simply to expose the juice to the action of the sun, which in a short time, varying with the humidity of the atmosphere, dries the mass. This however is attended with several difficulties, first the loss of time occupied in the process, (5 days being the shortest time that even a thin layer of gum can be dried in the dry weather, and in the wet season three and four months often elapse before a thin film even appears on the surface). The action of the atmospheric oxygen however during this process is so great that a quantity of either the gum itself or some of the other juices of the tree become oxydized, the whole mass becomes strongly acid, acquires the same smell as stale juice and what is worse than all becomes of a dirty brown colour, which is very difficult to remove. Another method which certainly has neither of the deficiencies of the former one is to act upon the juice with strong alcohol. By this means it is immediately coagulated, a large portion of the alcohol seeming to

join chemically with the juice. A fine white article is produced, but one that is stated by the English manufacturers to be almost useless on account of the action of the spirit. The last and the best method that I have experimented with is to drive off the water by means of steam at 100° C (boiling over a naked fire cannot be made use of, as a large quantity of the juice becomes burnt and destroyed). This drying is accomplished in large leaden trays fitted in boxes, a space of an inch and a half being allowed between the lead and the box. Steam from a boiler under ordinary atmospheric pressure is allowed to pass into the box and circulate around the leaden tray; the gum is then poured into the tray and kept constantly stirred up by wooden stirrers so as to prevent a film forming at the surface. In the course of an hour and a half the mass will have become almost dry; it is then removed from the leaden tray and exposed to the air for two or three days to become entirely dried and hard. This process furnishes us with an article having a pink colour and which requires but little purification to render it fit for exportation. Great care must be taken in all these processes that no vessel or article of Iron or Tin be employed in the preparation, as by its action the colour of the substance is changed and becomes almost black, owing to the presence of tannin or tannic acid in the juice itself. To obviate this, all vessels or tools employed are made either of lead or copper.

The Gutta Percha prepared by any of the above processes will find a ready market in England, France, Germany and the United States, and of course an article of superior quality will bring a higher price. Any samples prepared as above may be purified by simply boiling with

water for some time, when the greater part of the coloring matter will be removed, and the Gutta Percha itself on being submitted to pressure will become more impervious to water than before. In its chemical properties Balata resembles both Gutta Percha and Caoutchouc. It is dissolved by the same substances in which they dissolve. On treatment with sulphur it yields a splendid variety of ebonite. Its chemical properties and some chemical processes for its purification I propose to bring before the Association at a future meeting. The Balata tree yields its juice most abundantly during the wet season in Trinidad, and during the months of April, May and June one may tap hundreds of trees and obtain no juice at all. If however the trees, as they rarely do, grow in a swamp, the tapping may be continued throughout the year. The best time to tap the trees is during the fall of the moon, the quantity obtained from each tree gradually decreasing, and after the new moon it is almost useless to tap the trees. It is a curious fact that an old tree and especially a hollow one, yields, in proportion to its size, far more juice than a young tree. The process of tapping the tree while standing removes such a very small proportion of its sap that it does not materially affect the growth, more especially as old trees are almost invariably chosen for tapping. A tree having been tapped will be found in the course of a few months to have formed a new bark which completely fills up the incisions made in tapping.

The production of Gutta Percha from the Balata in Trinidad cannot fail in my opinion shortly to become an important branch of industry in the Colony. The demand for the substance in Europe and America is almost un-

bounded and shows no signs of becoming less; the price at which the substance can be prepared here is very little and leaves a margin for an enormous profit on sale in England. It is a work that would bring into employ at good wages a large number of laborers, and as the supply of the Balata itself is almost unbounded it might be made with proper supervision a source of large revenue to the Colony.

I must apologise for the imperfect way in which I have brought this subject before you, and I hope in a short time to be able to contribute a paper on the Chemical composition and properties of this interesting substance.

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*Tuesday, August 12th,* 1873.

H. W. Caird Esq., M.A. President in the Chair.

The following donation was announced:

"Journal of the Society of Arts," Nos. 1070—1077—*from the Society.*

The following gentlemen were proposed as ordinary members of the Association:

J. A. Lea Esq., L.R.C.P. Lond., John Arnold Esq. L.R.C.P. Lond., John B. White Esq., M.R.C.V.S. Lond.

*Tuesday, September 9th,* 1873.

At Mr. R. Guppy's house, La Falaise, San Fernando.
H. W. Caird Esq., M.A. President in the Chair.

The following donation was announced:

"Journal of the Society of Arts, Nos. 1078—1082—*from the Society.*

Julian Augustus Lea L.R.C.P. Lond., John Arnold, L.R.C.P. Lond. and John Brandford White, M.R.C.V.S. Lond. were elected members of the Association.

The following communication was read:

SOME REMARKS ON THE QUALITY OF THE WATER SUPPLY OF PORT-OF-SPAIN, and on the Waters proposed to be used for the supply of San Fernando; with a note on the quality of the Water from the Piparo Spring.

I have much pleasure in placing before the Association the results I have obtained by the analysis of some samples of drinking water used in this Island. First, the waters daily supplied for use in Port-of-Spain from the St. Ann's and the Maraval rivers, and second, the analyses of some waters proposed to be used for the supply of the Town of San Fernando. With regard to the quality of the water-supply of Port-of-Spain, little can be said to its disadvantage; both samples are nearly free from organic impurity, and shew but little contamination with the results of decomposed animal or vegetable matter. The water supplied from St. Ann's reservoir is slightly harder than that from the Maraval, and slightly less contaminated with organic impurity. Compared with the water supplied to some of the great towns in Europe, London for instance, these waters shew well, being in almost every respect superior. It must however be borne in mind that the samples were

collected towards the end of the dry season, when they would have acquired the greatest amount of purity, owing to the long continued action of filtration through the rocks, &c., and the continued action of the atmospheric oxygen, both of which causes would tend to reduce the amount of animal and vegetable impurity to a minimum. The presence of nitrogen in the form of nitrates and nitrites may be due either to the oxidation of animal matter, such as manure, &c., which contains nitrogen, or to washings from the strata through which the water passed after its descent to the earth in the form of rain. In either case it is generally expressed by English chemists now, by being converted into an expression shewing the amount of "previous sewage contamination, the result being expressed in numbers derived from a series of experiments made with average London sewage, and shewing the amount of such sewage that would be required to produce on oxidation the necessary amount of nitrogen in the form of nitrates and nitrites. All waters however, even rain water, contain a small amount of nitrogen in the form of ammonia and of nitric acid derived from the atmospheric nitrogen, so that this amount which has been carefully estimated by a long series of experiments has to be deducted from the amount found in any water before estimating the "previous sewage contamination."

The three samples of water I have examined, which are proposed to be used for the supply of San Fernando, are—1st—from the Hot Springs at Point-à-Pierre—2nd—from the Morichal Spring at the foot of the Montserrat Hills, and the 3rd from the Morocoy Spring near the same place. The analyses were performed on very small quantities of the water, so that they are not so accurate as I could wish.

They prove however that all the waters are fit for drinking purposes, more especially that from the Morocoy Spring. The sample from the Morichal Spring contained a large amount of lime, although collected at the best time in the year for its purity. The quantity was so great in fact that I am afraid that the pipes employed to carry the water to San Fernando from the hills would, before long, become choked with a deposit of the insoluble carbonate of lime, which would inevitably be separated from the water on exposure to the air for any length of time. This might however be easily obviated by treating the water in the collecting reservoir by a process called Clarke's process, by means of which all the lime present in the water, and expressed in the following analytical table as temporary hardness, would be removed. This process could easily be carried out at Montserrat, and could also be readily and with but small expense applied to the supply at Port-of-Spain. The principle on which it is founded is that the lime which exists in the water, and can be removed by boiling, is simply held in solution by the presence of free carbonic acid, and that as this carbonic acid can be converted into an insoluble compound, both it and the lime which it holds in solution can easily be removed from the water. To effect this we make a careful examination of the water to find out the amount of lime thus held in solution, and then add to the known volume of water just sufficient quicklime to combine with the whole of the free carbonic acid, and so convert it into an insoluble carbonate of calcium, which soon settles down and leaves the clear purified water above it. To carry out the process we should require to build a double set of reservoirs, each capable of holding at least one week's supply for the town. The process of precipitation and settling of the deposit

would be constantly going on in the one, while the clear purified water in the second would be employed for the supply of the town. The chemical processes required for the determination of the amount of lime in the water and the amount necessary to be added in order to render it insoluble are very simple and would occupy but a short time. The deposits of insoluble chalk or carbonate of calcium at the bottom of the reservoirs would require to be removed about once in six months, and as the reservoirs in use for this process would be covered over no other cleaning would be required. This process in fact to a great extent does away with any necessity for settling beds and filtering reservoirs, as these two processes are carried on together in the precipitating reservoir itself. Not only does the water after treatment by this process become softer, but it also loses to a great extent the organic impurities that previously existed in it. As a proof that it is quite practicable for use in this island I may mention that it is used in some towns in England, where the water is hard, which are far larger than even Port of Spain, viz., Croydon, Canterbury &c.

As for the other two sources by which it is proposed to supply San Fernando, both of them have great disadvantages, which are not in my province to discuss, belonging properly to the Engineer. I may state, however, that both the Morocoy sample and that from the Hot Springs at Pointe-à-Pierre are in their natural condition superior to that from the Morichal Spring. The following table of analyses will shew for itself the differences which exist between these waters.

Note.—Since writing the above I have been informed by Mr. Meagher, the Superintendent of Public Works, that he visited the Montserrat Springs on July 29th instant, after two months of rain, and found that the whole of the Springs were dry. He however collected a sample of water higher up in the hills, from the Piparo Springs, and this was forwarded to me for analysis. I found that the sample was turbid and would consequently require filtration before consumption. I also found that in all respects except the quantity of dissolved organic matter it was less pure than any of the other samples from the same district. The quantity of lime present in the form of sulphate and which constitutes what is known as permanent hardness was so great that it would render the water very injurious for human consumption and also cause the water to be of little value for washing and other purposes. The chloride of sodium also exists in large quantity and this together with the fact that nitrogen is present in the form of nitrates and nitrites shews that the water after its descent to earth in the form of rain had become contaminated with a large amount of decomposing organic matter, most probably animal refuse. These impurities may however have been derived from the strata through which the water passed owing to the remains of fossil shells, &c., which contain large quantities of nitrates, and would be washed out by the water. For all these reasons I think that this water is not at all suited for the supply of San Fernando, or for use in any way as a drinking water.

## Results of Analysis expressed in parts in 100,000.

| Name of Sample. | Total Solid Impurity. | Organic Nitrogen. | Organic Carbon | Ammonia. | Nitrogen as Nitrates and Nitrites. | Sulphate of Sodium. | Chloride of Sodium. | Hardness | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Temporary. | Permanent. | Total. | |
| Hot Springs at Point à Pierre .. | 26·8 | ·529 | .. | ·008 | ·030 | 14·60 | 5 27 | ·00 | 2·40 | 2·40 | .. |
| Morichal Spring ... | 44·0 | 1·714 | .. | ·028 | ·243 | 5.90 | 3·29 | 16·03 | 6·00 | 22 03 | .. |
| Morocoy Spring .. | 23·10 | ·119 | .. | ·000 | ·008 | 3·00 | 2 47 | ·34 | 8·23 | 8·57 | Clear |
| Water supplied to Port of Spain from St. Ann's Reservoir, April 1st, 1873 .. | 30·10 | ·018 | ·187 | ·002 | ·247 | .. | 3·790 | 2·43 | 7 43 | 9·86 | Clear |
| Water supplied to Laboratory from Maraval Reservoir, March 19th, 1873 .. | 27·88 | ·024 | ·203 | ·003 | ·206 | .. | 2·802 | 2·03 | 5·90 | 7·93 | Clear |
| Water from the Piparo Spring, Montserrat .. | 80·03 | ·030 | ·106 | 000 | 2·49 | .. | 8·87 | 16·63 | 40·61 | 57·24 | Turbid |

*Tuesday, October 21st*, 1873.

ANNIVERSARY MEETING.

H. W. Caird Esq., M.A., President in the Chair.

The following donations were announced:

"Journal of the Society of Arts," Nos. 1083—1088 *from the Society.*

M. Sars & G. O. Sars on some remarkable forms of Animal life from the great deeps off the Norwegian Coast.

S. A. Sexe—On the Rise of land in Scandinavia.

F. C Schüler—Die Pflanzenwelt Norwegens.

H. Tveter—The Thelmark Race (Cattle).

Leasing of the waters not containing fish, belonging to the Norwegian State.

M. G. Hetting—Die Fisch-Cultur Norwegens,

Tillæg J.—Til Beretningen om Ladegaardsoens Hovedgaard for Aarene 1862 og 1863.

Almindelig Norsk Haus Kalender 1859.

Anden Beretning om Ladegaardsoens Hovedgaard.

*All from the Royal Northern Academy of Christiania.*

The Report of the Secretary for the year ending 30th September, 1873 was then read:—

ANNUAL REPORT OF THE SECRETARY.

In accordance with the annual custom, I beg to pres the following report on the condition of the Association.

On the 30th of September last the Association was co posed of the following numbers:—

| | |
|---|---|
| Members .. .. .. | 26 |
| Honorary Members .. .. | 3 |
| Corresponding Members .. | 10 |
| Total .. | 39 |

17 of the above 26 members have expressed their desire to continue to belong to the Association and 9 are absent from the Colony, and from the remaining 2, no answer has been received.

Three Members and two Corresponding Members have been elected since I assumed the office of Secretary in April last, and during that period, two members have sent in their resignations.

Considerable satisfaction has been felt by all members with the permission given by His Excellency the Governor for the meetings of the Association to be held in the Laboratory.

Although the meetings of the Association have been held regularly each month, the attendance of members has not been so great as could be desired.

Financially the condition of the Association is good. After paying heavy printing accounts during the last quarter, the balance in the hands of the Treasurer amounted to rather over $28.

It will be satisfactory to all members to know that arrangements are being made to print all future publications of the Association in London, in better style and at a much lower cost than has been incurred hitherto.

The following papers have been read since April last:

1. Krebs.—On the "West Indian Rissoinæ."
2. Day.—On the "Preparation of Gutta Percha from the Balata Tree."
3. Day.—"Some remarks on the quality of the Water supply of Port-of-Spain, and on the waters proposed to be used for the supply of San Fernando" with a note on the quality of the water from the Piparo Spring.

The first part of Vol. II. (No. IX.) of the proceedings of the Association has been issued during the past year.

JAMES JOHN DAY, F.C.S.
Secretary & Treasurer.

The following gentlemen were elected as members of the Council for the ensuing year :—

Dr. Knaggs President.
H. W. Caird, R. J. L. Guppy } Vice Presidents.
J. J. Day Secretary & Treasurer.

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*Wednesday, November 19th,* 1873.

Dr. Knaggs, President in the Chair.

The following donations were announced :—

"Journal of the Society of Arts" Nos. 1089—99 *from the Society.*

Memoirs Vol. II. part I., and proceedings Vol. XIII. Sigs 15—23—*from the Boston Society of Natural History.*

W. T. Brigham—Earthquakes of New England and Smithsonian Report 1869,—*both from the Smithsonian Institution.*

Almindelig Norsk Haus Kalender.

Det Kongelige Norske Frederiks Universitets Aarsberetning for Aaret 1869.

Rapport sur l'etat de la statistique officielle du royaume de Norvège.

Index Scholarum in Universitate Regia Fredericiana.

Indberetning om Norges Deeltagelfe i den almindeligo Industri Udstilling i Stockholm i 1866 og i Bergensudstilling i Paris 1867.

C. A. Holmboe. Ezechiels Syner og chaldœernes Astrolbar.

M. Sars—Des Crinoïdes vivants.

S. A. Sexe—Le Glacier de Boium.

M. Irgens og J. Hiortdahl—Om des Geologiske Forhold paa Kyststrœkminigen af Nordre bergenling amt.

C. de Sene—La névé de Justedal et ses glaciers.

*All from the Royal Northern University of Christiania.*

The following communication was read:—

## ON SOME NEW TERTIARY FOSSILS FROM JAMAICA.

By R. J. Lechmere Guppy F. L. S. F. G. S., &c.

### § I.—Introductory Remarks,

Mr. Vendryes, an ardent naturalist and zealous collector of shells and fossils in Jamaica, has kindly forwarded to me a fine set of the miocene fossils of that island. These have been in my possession for some time: but although several novelties are contained in the collection, want of time and opportunity has hitherto prevented my working them out. The high interest attaching to these fossils has however induced me to draw up descriptions of the new species, and to indicate those which although previously described from other localities are now for the first time added to the Jamaican list.

The determination of the geological age of the Jamaica beds and of the remarkable relations of the fossil fauna of the Westindian miocene to that of Europe and the living fauna of the eastern seas is strikingly supported by the new fossils now described. We have a Murex, an Ovulum, a Cassis and a Fasciolaria whose nearest congeners are European miocene and Asiatic recent; a Scalaria, previously described indeed, but from inadequate material, whose relations are similar, and a Naticina, a genus almost extinct in the Westindies, but whose present distribution is along the path pointed out as that of the migration of

organized beings during the Tertiary period from America to the Pacific Ocean through North Africa and South Europe.

Among the collection it will be noticed that there are a few shells, e. g. *Turbo castaneus*, *Strombus pugiloides*, and *Plicatula vexillata*, which like the *Conus fuscocingulatus* of the European miocene, retain traces of the coloring which ornamented them while living. It is only where the strata are of such composition as to be extremely favorable to the preservation of molluskan remains that such a circumstance could occur. In Jamaica and Haiti the miocene formations have been remarkably suited to this end, and hence we have from them a series of organic remains scarcely surpassed in beauty even by those of Bordeaux, Dax or Paris. In Trinidad the shells of similar age are for the most part extremely altered and their characters more or less obliterated. It is therefore fortunate that we have those of Haiti and Jamaica upon which to found and rectify our determinations of the Trinidad rock and fossils of like age.

The list of Jamaica fossil shells is now made as complete as the materials in my hands will allow: all the species known to me which are well enough preserved to admit of identification are described or named either in the present paper or in that published in the Journal of the Geological Society vol. xxii., p.p. 281—295.

I ought not on the present occasion to pass by without notice the very important addition made to the Scientific literature of the Westindies by the publication of the Geological Report on Jamaica. To Trinidad belongs the honor of having initiated the Geological Survey of the Westindies: but the complicated nature of its physical structure, and the imperfect condition of the fossils found

here have operated to render the report on our island far less complete than that of Jamaica. Besides this, since the Report on Trinidad has been published, a great deal of work has been accomplishd on the paleontology and natural history of the Westindies; and the relations of the fossil shells, echinoderms, corals and foraminifera of the Caribean area have been largely worked out. Sir Roderick Murchison remarks in his preface to the Jamaica Report that the Appendix to that report by Mr. Etheridge, paleontologist to the Geological Survey of Great Britain, is not the least valuable portion of the book: and indeed I may say that to Naturalists it is the most interesting part of it. Mr. Etheridge's appendix relates to the paleontology of the island; and in it he has done full justice to the labors of Professors Duncan, Rupert Jones, and others, whose results have been published, with excellent illustrations for the most part, in the Journal of the Geological Society and in the Geological Magazine. He has presented such a resumé of our knowledge of the paleontology of the Caribean area as cannot fail to be highly useful if not indispensable to every worker on the Geology of that area. On one point alone have I to say anything in disparagement of this report—that is the numerous misprints in all the appendices, but particularly in the botanical and paleontolcgical portions. In all other respects the work is well executed: there are, besides a general geological map of the island, numerous detailed sections showing the structure of the island.

§ II.—Description of the Fossils.

*Hyalaea (Diacria) vendryesiana* n. sp. Pl. II., figs. 2a. 2b. Shell elongate, smooth; both valves somewhat inflated, but the superior one more so than the other: terminated on each side by two short sharp mucrones, and posteriorly

by a narrow curved mucro not so long as the body or main portion of the shell. Lips everted, the inferior one bordered exteriorly by a raised ridge which towards the lateral mucrones gradually becomes confluent with the edges of the lips. Length 5 mm. of which the terminal mucro forms about 2. Breadth nearly 3 mm.

Related to *H. inflexa* and *labiata* of D'Orbigny—It differs chiefly in being more inflated, especially the inferior valve, and in being narrower behind the lateral mucrones, a character it would seem of some importance in this genus.

The length of the terminal portion of the shell seems to be relied upon as the distinction between *Diacria* and the more typical members of the genus *Hyalaea*. The present species belongs to *Diacria* on account of this character.

*Scalaria leroyi* Guppy—Plate 1, f. 10

Proceedings of the Scientific Association of Trinidad 1867, p. 168.

Turreted, cylindric, many-whorled, cancellated by numerous transverse and spiral costellae, except on the base which is spirally striate only. Aperture suboval. Pillar-lip somewhat everted forming a callus on the columella. Outer lip simple, sharp, a little dilated anteriorly. Whorls regularly rounded, suture deeply sunk.

My original description of this shell was drawn up from an examination of the specimens found in Trinidad which are so much altered by fossilization that the character of the surface is not determinable. The examples from Jamaica are in good preservation, though they are not so large as those found in Trinidad, one of which is more than six inches long. Some of the specimens from Jamaica exhibit a variation in the character of the surface which might induce a belief that there are two species. I do

not however take that view. One beautiful example has the transverse costellae larger and more distant than the spiral ones, the latter being threadlike and rising upon the former. In this example the spiral striation of the base is also more marked. *Sc. leroyi* may be compared with *Sc. magnifica* Sow.; but there are points of resemblance between it and *Sc. decussata, raricosta,* and *lineata.* None of the recent Westindian species bear any resemblance to the fossil except in that general shape which is common to nearly all the members of the genus. On the whole however the nearest ally of the Jamaican fossil may perhaps be found in *Sc. tenuistriata* Orb. (Bahia Blanca).

*Ringicula tridentata* n. sp.

Ovate-conic, moderately thick, smooth, shining. Spire conic. Whorls about 4. Aperture suboval: columella thickened and bearing two strong spiral plaits, the callus continued backward, and carrying a stout tooth on the body-whorl; the latter separated by a deep notch or canal from the thickened and somewhat everted outer lip. Length nearly 2 mm. breadth about 1.

Distinguished from *R. semistriata* Orb. (Cuba shells, vol. ii, p. 103, pl. xxi, f. 17—18) by a wider mouth and less thickened outer lip. *R. tridentata* does not exhibit any trace of the striation which marks the anterior portion of *R. semistriata,* which was described by D'Orbigny as a recent shell from Jamaica.

*Natieina regia* n. sp. Pl. II, f. 6.

Oval oblong, spirally striated by fine equidistant grooves, which are crossed by a few rather irregular lines of growth. Whorls about 5, the last very large. Spire short, acuminate. Aperture semioval rather narrowed above. Umbilicus round, very partially hidden by the everted columella

callus. Outer lip sharp, indistinctly dentate. Length 15 mm. Breadth nearly 10.

Closely akin to *N. lamarckiana* from which it is distinguished by its narrower mouth. It is almost as near to *N. papilla* (Africa) but it is less elongate in its proportions.

*Bulla vendryesiana* n. sp. Pl. I, f. 6.

Rimate, rather cylindrical-ovate, solid, smooth. Spire deeply sunk. Aperture longer than the shell, dilated anteriorly. Inner lip covered with a callus which is everted over the narrow umbilicus, and extends backward to the canal separating the body-whorl from the sharp outer lip. Length about 15, breadth about 9 mm.

Allied to *B. striata* Brug. particularly to that form called *B. maculosa* Mart. The surface of the fossil is not well preserved, and does not admit of an exact description of its characters. *B. vendryesiana* is rather more cylindrical in shape than *B. striata*, and from *B. maculosa* to which it is nearer in figure it is distinguished by its greater solidity and its thicker and more everted columella callus.

*Tornatina coixlacryma* Guppy.

Geological Magazine, vol. iv (1867) p. 500.

*Tornatella textilis* n. sp. Pl. I, f. 4.

Oval-oblong, solid, a little ventricose, closely cancellated by numerous spiral riblets and finer longitudinal threads most distinct in the spiral grooves. Spire short, conic. Whorls about 7. Aperture elongate, narrow, dilated anteriorly into a canal. Columella twisted, bearing a single stout fold. Outer lip sharp, finely dentated by the spiral riblets. Length 17, breadth 9 mm.

In shape this shell approaches *T. fasciata*. It is of more solid structure, its spire is somewhat shorter, and it is at once distinguished by its cancellated surface.

*Cancellaria scalatella* n. sp. Pl. II, f. 4.

Turreted, umbilicate, spirally striate by numerous close spiral threads more elevated on the stout rounded longitudinal variciform ridges of which there are 6 or 7 on a whorl. Suture very deeply sunk. Whorls about 7, slightly rounded, angulate and crowned above by the ridges. Aperture almost triangular, rounded above, angular and formed into an obsolete canal anteriorly. Outer lip sharp, grooved within. Inner lip continuous, thin, sharp, slightly reflected and bearing two folds. Base angulate, perforated by a small round umbilicus.

Related to *C. varicosa* Brocchi (Miocene, Piedmont); but smaller and of somewhat stouter figure. The spiral striae are coarser, and the peristome is finely grooved instead of being coarsely dentate only. In *C. varicosa* the spiral striae are crossed by very fine longitudinal ones, which do not exist in *C. scalatella*. The most striking difference however is that the whorls are rounder and the suture much more deeply sunk in *C. scalatella*, whilst the longitudinal ridges project upon the angle of the whorls so as to give a coronate appearance.

The three Cancellariae hitherto described from the Jamaican miocene are all akin to European fossils of the same date; but two of them belong to the type of the recent *C. reticulata*. The present is of more decidedly miocene aspect than either of the three previously described.

*Ovulum immunitum* n. sp. Pl. I, f. 7.

Fusiform-elongate, pointed at both extremities. Outer lip thickened, extending in a nearly regular slight curve from the posterior to the anterior canal; slightly dilated anteriorly. Inner lip with two strong folds at the anterior end. Aperture as long as the shell; narrow posteri-

orly, growing wider gradually until near the middle of the whorl, then increasing in width by the expansion of the outer lip and the recession of the whorl to form the slightly twisted pillar lip. Length about 20, breadth about 7 mm.

Allied to *Ov. leathesi* Wood of the English Crag. It is nearly of the same size, but is more slender in its proportions and in some particulars is more close to *Ov. spelta*, including under that term both the fossil and recent species so called.

*Turritella tornata* Guppy.

Journal Geol. Soc. vol. xxii, p. 580, pl. xxvi, f. 12.

This shell occurs also in the Miocene of Haiti and Trinidad.

*Conus recognitus* Guppy.

C. solidus, *Sowerby*, Journ. Geol. Soc. vol vi, p. 45.

C. recognitus, *Guppy*, Proc. Scient. Assoc. 1867, p. 171.

The name *solidus* having been used for another Cone, I proposed in 1867 the name of *recognitus* for this species.

*Conus consobrinus* Sow. Pl. II, f. 4.

*Sowerby*, Journ. Geol. Soc. vol. vi, p. 45.

I have referred this shell to Sowerby's species, but if my determination be correct Sowerby's description is in need of amendment. The zones or rather spiral ribs can scarcely be called granose, although they exhibit a tendency to become so towards the completion of the last whorl, which is usually devoid of the tubercular crowning of the previous whorls.

This species was hitherto only known from Haiti, but it is now added to the Jamaican list.

*Pleurotoma henekeni* Sowerby.

Journal Geol. Soc. vol. vi, p. 50, pl. x, f. 6.

*Pleurotoma haitense* Sowerby.

Journ. Geol. Soc. vol. vi, p. 50.

*Ficula carbasea* Guppy.

Journ. Geol. Soc. vol. xxii, p. 580, pl. xxvi, f. 7.

Previously known from Anguilla and Trinidad.

*Purpura miocenica* n. sp. Pl I, f. 9.

Subpyriform, rather ventricose above, rimate, narrowed and produced anteriorly, adorned with longitudinal ribs (about 10 to the whorl) which are crossed by coarse rugose high narrow spinal ridges or threads. Whorls about 6, apex acuminate. Pillar lip smooth, reflected over the shallow umbilical fissure. Canal produced. Outer lip sharply dentate by the spiral ridges. Length about 22, breadth about 15 mm.

The outer layer of the shell is usually removed, and where this is the case each spiral rib appears to be double; but when the outer surface is preserved the somewhat foliated or echinated rugosities of these ribs are very obvious.

This is a Coralliophila, and is related to the *P. galea* (Chemn.) of D'Orbigny of which the name ought probably to be *P. plicata*, the appellation *galea* being the rightful property of a closely allied Eastindian shell. Another form with which the Jamaican fossil may be compared is *P. squamulosa* Reeve.

*Fasciolaria textilis* n. sp. Pl. I. f. 5.

Elongate, fusiform, closely cancellated by numerous spiral ridges from 1 to 2 mm. distant between which are (especially anteriorly) one, two, or three finer threadlike ribs; and by numerous closer and smaller longitudinal lines. Whorls 6, the first two of which are smooth, the

apex deciduous and usually wanting, the last more than two-thirds of the shell, rather ventricose above the middle, produced and rather attenuated anteriorly; bearing on the upper half 5—7 elongate rounded tubercular prominences. Columella margin with three strong tooth-like plaits.—Interior of peristome smooth. Length nearly 70 mm. breadth 30.

The cancellation gives to the surface an appearance like that of coarse cloth or bagging. This species should be compared with the *F. intermedia* of Sowerby from the Haitian miocene. It bears a resemblance to *F. filamentosa*, but is shorter, stouter, and less angular in all its features except only the tubercles, which are disposed in similar fashion, but are perhaps somewhat larger and more elongate. It is very different from *F. tarbelliana* Grat. which occurs at Cumana in Venezuela, as well as in Chili and Europe. *F. textilis* exhibits the close alliance of the genus to *Turbinellus*.

*Phos erectus* n. sp. Pl. I, f. 1.

Solid, turreted, conic-cylindric, finely striated longitudinally and adorned with stout longitudinal variciform ridges which are highest on the angle of the whorls, become obsolete at the shallow suture and are twisted at the base: coarse spiral threads cross the longitudinal grooves and ridges, rising on the latter into low scarcely noticeable tubercles. Whorls about 9, increasing very gradually, slightly angulated, the last forming more than one half the length of the shell. Aperture rather narrow. Columella twisted bearing one spiral plait. Outer lip simple, having 12—15 entering grooves, and furnished with a small sinus near the anterior canal; joined posteriorly with the body-whorl by a callus. Length about 21, breadth about 10 mm.

*Phos solidulus* Guppy.

*Nassa solidula*, Quart. Journ. Geol. Soc. vol. xxii—p. 579. pl. xxvi. f. 11.

*Strombus pugiloides* n. sp.

The shell for which I propose the above appellation was considered to be *Strombus pugilis* by Mr. Carrick Moore. The name was misprinted *fragilis* in his paper in the Journal of the Geological Society, vol. xix, p. 511. In my papers on the tertiary fossils of Jamaica and the Westindies the species was recorded under the name *Str. pugilis*. In ordinary specimens like those usually found in Jamaica, Haiti, and elsewhere the only well-marked differences that can be noticed between the fossil shell and the recent *Strombus pugilis* are that in the former the last whorl is usually devoid of the spiniform tubercles and that the shell is of shorter and broader figure. But some examples supplied me by my friend Mr. Vendryes exhibit an unexpected character. They show chevron-shaped bands of color, about 12—15 on the last whorl. Each band takes the shape of a V, the apex of which occurs near the middle of the whorl and forms an angle of about 30° pointing backwards or away from the aperture. These bands of color are about 2 mm. wide and the spaces between them are about 3 mm. Numerous specimens of the recent *Str. pugilis* have passed through my hands, but I have never noticed the slightest approach to such a character. The recent shell is pale red or pink only relieved by an indistinct band of paler tint following the middle of the whorl. A less constant difference may be found in the low rounded lamellar dentition inside the outer lip which is very faint or altogether wanting in *Strombus pugilis*, but more marked in the fossil.

*Strombus bifrons* Sowerby.

Journ. Geol. Soc. vol. vi, p. 48, pl. ix, f. 9.

*Murex collatus* n. sp. Pl. I, f. 8.

Ovate, rimate, slightly flattened, adorned with numerous thin slightly fimbriate or crenulate varices often doubled especially the later ones; about 7 on the last whorl; their interstices indistinctly crossed by low transverse costae which terminate in points on the varices; the upper point large, acute and projecting, giving an angulate appearance to the shell: varices uniting below to form an irregular and contorted canal. Whorls 6—7, somewhat angulate. Spire sharp. Outer lip expanded and crenulate, obtusely dentate within. Pillar lip smooth. Length about 25 mm. Breadth about 15. Total length of last whorl including canal about 18 mm.

Very closely related to *M. calcitrapa* Lam. (Eocene, Europe). It is smoother and the whorls less angulate. These shells belong to a small group of Murices which exhibits the connection through *Trophon*, *Rapana*, *Latiaxis*, *&c.* to *Purpura*. *M. collatus* would perhaps be ranked by some conchologists as a *Trophon*, as has already been done with *M. calcitrapa*.

*Typhis alatus* Sowerby

Journ. Geol. Soc. vol. vi., p. 48, pl. x, f. 4.

A species almost as near to *T. tubifer* (Eocene, Europe) as *Murex collatus* is to *M. calcitrapa*. The living analogues of *T. alatus* are *T. pinnatus* and *T. sowerbyi*.

*Ancillaria pinguis* n. sp. Pl. I, f. 3.

Ovate conic, spire elevated, acuminate. Suture usually visible through the enamel which covers the spire and accompanied at a little distance by a keel the ridge of which is threadlike. Aperture suboval, elongate—Um-

bilicus deep, narrow, partly hidden by the callosity of the inner lip. Columella callus strongly twisted—central portion of last whorl without enamel.

Bears some resemblance to *Anc. lamellata* Guppy. A near relation is perhaps *A. rubiginosa*, which has a spire of similar character.

*Ancillaria glandiformis* Lam.

I think it possible that some of the examples of *Ancillariæ* from Jamaica belong to this species, as I noticed in the Geological Magazine, vol. iv., p. 498.

*Cassis reclusa* n. sp.

Ovate, ventricose, sulcated by about 18 narrow and shallow equidistant spiral grooves, the flattened intervening ridges being raised into knobs by somewhat obscure longitudinal costae. Spire conic, cancellated. Apex smooth, blunt. Columella expanded into a granose callus; canal short: outer margin thickened and reflected, dentate.

Very closely related to *C. subulosa* (a Bordeaux fossil). It is chiefly to be distinguished by its larger spire and apex, generally narrower and less ventricose figure, and somewhat stouter ornamentation. Amongst recent Westindian species the nearest relation of *C. reclusa* is *C. granulata* ( ?=cicatricosa Meusch.)

*Crepitacella cepula* Guppy.

Melanopsis cepula, Journ. Geol. Soc. vol. xxii, p. 580, pl. xxvi. f. 14.

Crepitacella cepula, Geol. Magazine, vol. iv. (1867) p. 500.

This shell is related to *Cyllene pulchella* Adams. It is not impossible that some other fossils described as Melanopsis really belong to the group *Crepitacella*.

*Monodonta basilea* n. sp. Pl. I, f. 2.

Top-shaped, umbilicate. Apex smooth, sharp. Whorls about 7, very strongly carinate, the stout keel on the angular ridge bearing a row of rounded undulate tubercles and having near the suture a less distinctly marked keel, between which and the keel on the angle there is a slight concavity marked only by faint spiral ridges crossed by lines of growth. Lower half of last whorl forming the base covered with strong spiral ridges. Mouth subcircular. Columellar lip callous, produced into a broad tooth above a short broad rather effuse canal. Outer lip dentate, grooved within. Total length about 15, greatest breadth about 12 millimetres.

In general characters there is some resemblance between this shell and *Trochus cypris* Orb. (=*Monodonta elegans* Bast.)

*Neaera costellata* Desh.

*Corbula vieta* Guppy.

Journ. Geol. Soc. vol. xxii., p. 580, pl. xxvi. f. 8.

*Venus blandiana* n. sp.

Suborbicular, subequilateral, moderately convex, adorned with numerous equidistant concentric lamellae, between each of which there are about 7 or 8 concentric striae: somewhat angulate in front and subtruncate behind: margins crenate. Lunule smooth, impressed. Posterior dorsal area not defined, striate continuously with the lamellae of the disk. Umbones small. Cardinal teeth 2 under the lunule; lateral tooth 1 nearly halfway down the posterior slope.

Referred to hitherto in papers on Westindian fossils as *Venus rugosa* var., to young specimens of which species it bears a somewhat close resemblance. The Jamaican ex-

amples are smaller than those from Haiti. A specimen in the British Museum from the latter place is labelled *V. circinaria*, but it is not *Cytherea circinata*, nor even nearly allied to it.

When describing *Cytherea juncea* from Cumana I omitted to point out the close kinship between that fossil and *C. circinata*.

*Chama involuta* n. sp. Pl. II, f. 5.

Left (attached) valve deep internally, very convex externally, often spiral, completing a turn and a half, covered externally with distant large foliaceous scales more or less erect, between which are small irregular diverging granose ridges. Right valve patulous, ornamented with numerous close concentric sinuous foliaceous laminae. Umbones large, prominent, spiral. Margin and laminar cardinal tooth crenate.

Mr. Vendryes suggested that this might be a *Diceras*; but I see no ground for referring it to that genus. It is certainly a very spiral chama; but otherwise its characters are in all respects those of the genus. It is apparently always attached by the umbo of the left valve, and the place of attachment is generally marked by the remains or impressions of the septa of corals. It has some resemblance to a recent species found in the Westindies, which if I have identified it correctly is *Ch. ruderalis* Lam. but besides other considerable differences the latter is always attached by its right valve.

*Plicatula vexillata* n. sp. Pl. II., f. 7.

Inequivalve, irregularly fanshaped ; valves, usually with the disk almost smooth, adorned towards the margin by 7 or 8 stout obtuse radiating ribs along each of which are disposed a few lines of reddish brown (probably red when

alive) and between which are some distant almost foliaceous concentric striae of growth. Longest diameter about 17 mill.

Very near to *P. ramosa* Lam. Florida.

*Spondylus bostrychites* Guppy.

S. bifrons Sow. (name preoccupied). See Proceedings Scient. Assoc. Trinidad, 1867, p. 176.

*Leda clara* n. sp.

Subelliptical, lanceolate, nearly equilateral, somewhat but not extremely rostrated. Disk smooth, shining; Valves with a few fine close regular concentric riblets perceptible near the anterior angle where an indistinct sulcus runs upwards towards the umbo. No distinct escutcheon. Lunule narrow, indistinctly defined. Umbones prominent. Ventral margin slightly angulated at about a third of its length from the posterior point where an obscure carina runs to the margin from the umbo. Length 12 mill. height 6, thickness about 4.

In shape somewhat like *L. nasuta*. It is rather difficult to describe the smooth plain species of this genus; their differences being most generally noticeable in shape and extent of rostrum &c. The following species have been already described from Westindian tertiaries:—

| | | | |
|---|---|---|---|
| Leda packeri Forbes | Lower Miocene | Barbados. |
| incognita Guppy | ,, | ,, | Trinidad. |
| bisulcata | ,, | Upper Miocene | Jamaica. |
| illecta | ,, | Pliocene | Trinidad. |
| perlepida | ,, | ,, | ,, |

Three species of *Nucula* have been recorded from the same formations.

*Ditrupa dentalina* n. sp.

Tube clavate, curved, slightly irregular in diameter,

gradually increasing from the smaller end, which is annulate, becoming smooth towards the middle of the shell; the lower half smooth, shining, rather suddenly thickened near the aperture, to form which it as suddenly contracts to a diameter not greater than that of the smaller third of the tube.

There are no very distinct characters by which to separate this annelid case from *D. planum* of the European eocene. I have thought it as well nevertheless to indicate its presence in the Jamaica tertiaries under a provisional name.

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## EXPLANATION OF THE PLATES.

*All the Figures are of the Natural Size.*

### Plate I.

Fig. 1. Phos erectus
,, 2. Monodonta basilea
,, 3. Ancillaria pinguis
,, 4. Tornatella textilis
,, 5. Fasciolaria textilis
,, 6. Bulla vendryesiana
Fig. 7. Ovulum immunitum
,, 8. Murex collatus
,, 9. Purpura miocenica
,, 10. Scalaria leroyi
,, 11. Ditrupa dentalina

### Plate II.

Fig. 1, 1a. Leda clara
,, 2a, 2b. Hyalaea vendryesiana
,, 3. Conus consobrinus
,, 4. Cancellaria scalatella
,, 5a, b, c. Chama involuta
5a exterior of left valve
5b interior of left valve
5c exterior of right valve
Fig. 6. Naticina regia
,, 7. Plicatula vexillata
,, 8. Venus blandiana
,, 9. Conus prototypus. (The latter is a fossil from the Miocene of Trinidad.)

1873

PROC. SCIENT. ASSOC. TRINIDAD VOL 2. PL I

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J. Susini, lith

WEST INDIAN TERTIARY FOSSILS.

NATURAL SCIENCE

1876

PROC. SCIENT. ASSOC. TRINIDAD. VOL 2. PL II.

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1b 2

1c

5a

5b

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5c

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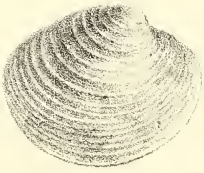
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J. Susini, lith.

WESTINDIAN TERTIARY FOSSILS.

NATURAL HISTORY.

*Wednesday, December 10th,* 1873.

Dr. Knaggs President in the Chair.

The following donation was announced, "Journal of the Society of Arts," Nos. 1092—95 *from the Society.*

The following Obituary notice of the late Hon. L A. LeRoy was read by the President:—

It falls to my lot, gentlemen, to bring under your notice the loss that this Association has recently sustained by the death of one of its oldest and most respected members, and I regret that the task is not in the hands of one better qualified by personal knowledge of the deceased for its performance, though in justice to myself, I claim a thorough appreciation of his sterling good qualities.

The Hon. Louis Alexander LeRoy was born at Ajaccio in Corsica, in November 1820; his father, who afterwards died as Governor of Lille in Flanders, being a Captain in the French service, and friend and companion-in-arms of the illustrious and unfortunate Ney, and his mother being a lineal descendant of the Comneni of Constantinople (1080.)

Mr. LeRoy was educated in France, was brought to Trinidad in 1839 by the late Mrs. Devenish, and on the Peru Estate, Mucurapo, prepared for the profession of a planter, which he subsequently embraced, and successfully pursued at Savanetta: no small portion of this success being due to his honesty, energy and talent.

In 1843 Mr. LeRoy married the youngest daughter of Mr. P. D'Abadie of this Island, and the grand daughter of St. H. Begorrat, who lives to mourn her irreparable loss.

He died in Marseilles of pneumonia after a few days illness on the 27th of October 1873, and the telegram that announced his death told of the unexpected bereavement

of a large family circle, and of the loss to the colony of the services of an earnest, honest, intelligent and independent member of Council.

The Legislature in Mr. LeRoy's death experienced the loss of a member to whose worth the representative of Her Majesty and his colleagues alike bore their testimony, and the Trinidad Scientific Association a firm supporter and well-wisher.

Although Mr. Le Roy did not contribute anything to scientific literature, he recognized the value of the fossils found on his estates at Savanetta as a clue to the geological age of the strata there developed; and the collections made by him have contributed to our knowledge of the fauna of the Middle Tertiary of this island.

The following communication was read :—

## ON NEW SPECIES OF BIVALVE MOLLUSKA FOUND AT CUMANA, VENEZUELA.

By R. J. Lechmere Guppy, F.L.S., F.G.S. &c.

One of the shells now to be described is a large and fine species of *Venus*. Specimens of this have been in my cabinet more than four years; but although it appeared to me unlikely that so large and handsome a shell should have escaped notice, yet I have not been able to find anything published relating to it. The species is certainly allied to *V. cancellata*, but by no means very closely. Its square equidistant ribs are not unlike those of *V. rugosa*, and the shape and color may recal *V. gallinula*, but it must be admitted that these resemblances are somewhat illusory.

The other shell is a *Mactra*, not belonging to the typical group of that genus, but on the contrary, somewhat of an aberrant form. It is a large and interesting species.

The recent not less than the fossil shell fauna of Cumana

is very interesting. Among the recent shells are several which are by no means common in the Westindies; as for instance the true *Persona reticularis* (Linn.) which though nearly allied to must not be confounded with the *P. clathrata* of Madagascar nor with the fossil *P. similima* of the Westindian Miocene. *Dispacus glabratus* occurs at Cumana: and I have also from that place an undetermined species of *Fusus* (which resembles young shells of *Fasciolaria gigantea* except that it has a longer canal), and also the following: *Solarium tesselatum*, *Phos guadelupensis*, *Venus flexuosa*, *Calyptraea auriculata*, (of which apparently there is a good figure in the large edition of Cuvier's Regne Animal pl. 48, f. 4, under the name of *C. cuvieri* Desh.) *Oliva reticularis* (several forms), and *O. monilifera* Reeve (? = *O. mutica* Say = *nitidula*).

*Venus superba* n. sp. Pl. III. f.

Ovate, slightly subtrigonal, a little inequilateral, ventricose; anteriorly produced and rounded; posteriorly produced and subangulate; umbones closely approximate; lunule large, striated with irregular diverging lamellae, distinctly defined by a sharp groove: posterior dorsal area large, striate, not distinctly defined. Valves marked with numerous irregular angulate streaks of chesnut or brown and adorned with numerous concentric crenate ribs, which are rather more distant, thinner, and more distinctly crenate near the anterior and posterior margins: on the disk the ribs are square, flattened and polished, and the crenation is less marked. Length 70, height 55, thickness about 45 mm.

*Mactra anserina* n. sp. Pl. III. f.

Oval, compressed, subequilateral, gaping widely posteriorly, anteriorly somewhat produced and subangular,

posteriorly high with a decided obtuse angle formed by a low keel running from the umbo, on the upper and posterior side of which keel the shell is covered with a black epidermis. Valves flattened, white, rather fragile, marked with concentric striae of growth, which are worn smooth on the disk and umbones, but towards the ventral margin are covered with a yellowish brown wrinkled epidermis. Length 85, height 60, thickness 30 mm.

The details of the hinge are somewhat similar to those of the hinge of *Hemimactra gigantea*, but the postcarinal area resembles that of *Schizodesma*. The latter feature is much developed in our shell, and is remarkable for its black epidermis, that of the other portions of the shell being of a light brown. *M. anserina* may possibly be allied to the *M. similis* of Gray in Beechey's Voyage, an Australian shell (not the *M. similis* of Say=*ovalis* Gould, which is an inhabitant of North America.)

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## Rules *and* Regulations *and* List *of* Members *of the* Scientific Association *of* Trinidad—1873–74.

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*The object of this Association is the cultivation of Scientific Knowledge in the West Indies.*

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### RULES:

1. This Association shall be called the "Scientific Association of Trinidad."

2. The objects of the Association shall be carried out by the reading of papers and the discussion of Scientific subjects, by maintaining a correspondence with scientific men in other countries, by assisting in the development

and application of Science in the West Indies, and generally by the collection and publication of useful information.

3. The Association shall consist of Members, Corresponding Members, and Honorary Members.

4. The Association shall, in October of each year, elect from among the Members a President, two Vice-Presidents, and a Secretary and Treasurer, who shall constitute the Council of the Association. Such Council shall have, subject to the Rules, the general management of the affairs of the Association.

5. The person who shall have filled the office of President in any year shall not be eligible for election as President for the next following year.

6. When any candidate shall be proposed for admission to the Association as a Member, he shall be balloted for at the next meeting thereafter, one black ball in five excluding.

7. The Association may elect as Corresponding Members such persons in the West Indies and elsewhere as from their services to Science are likely to contribute towards the advancement of the objects of the Association.

8. The Association may elect as Honorary Members such persons not permanently resident in Trinidad as may be desirable.

9. The Association shall meet on the second Wednesday in each month, or on such other day as may be fixed by the Council.

10. No motion relative to the Rules of the Association shall be brought forward except at a Special General Meeting of the Association; and no such motion shall be carried, except by a majority of at least two-thirds of the Members present at such Special General meeting.

11. One-third at least of the Members of the Association actually in the Island shall be required to constitute a Special General Meeting: and in order to constitute such Special General Meeting, it shall be requisite to give notice thereof at an ordinary Meeting.

12. Provided however that the ordinary Meeting in October of each year shall have all the powers of a Special General Meeting without respect to the number of Members present.

13. The Subscription of each Member shall be Five Dollars per annum, payable on the first day of October. Every new Member on election shall pay the subscription for the current year.

14. No member whose subscription shall be in arrear for three calendar months, unless at the time absent from the Island, shall be entitled to any of the privileges of membership.

15. The Secretary shall, at the monthly meeting in February of each year, lay before the Association lists of those Members whose subscriptions are in arrear.

16. Members may introduce Strangers to the meetings. Provided that no person shall be considered a Stranger after he shall have been resident in the Island three calendar months.

17. Every Member shall be entitled to one copy of each Paper printed since his election.

18. No Member shall be entitled to receive free any paper published during any period for which he shall not have paid subscription.

19. The Author of every Paper printed for the Association shall be entitled to haye six copies of such Paper.

20. Members desiring to obtain copies of the Proceedings of the Association, other than those to which they are entitled as specified in the preceding Rules, may have the same, as far as copies are available, on payment of the following rates:

When the Part of the half-yearly Journal shall not exceed 32 pages (for each part) .. .. .. 2s. 0d.
When the same shall exceed 32 pages (for each part) .. 3s. 0d.

21. Copies of the Journal of Proceedings of the Association may be sold to the public at the following rates:—

When the Part of the half-yearly Journal shall not exceed 32 pages (for each part) .. .. .. 3s. 6d.
When the same shall exceed 32 pages (for each part) ... 5s. 0d.

A Commission at the rate of twenty-five per cent. shall be allowed to the Agent, if any, appointed for the sale of such Journal; and the monies derived from the sale of Papers shall be applied to the purposes of the Association.

22. Corresponding Members not being required to pay any subscription may receive the parts of the "Proceedings" at the price charged to Members.

23. These Rules shall not be applicable to Honorary or Corresponding Members unless where expressly so stated.

COUNCIL (elected 13th October, 1869.)

Robert Knaggs, M.R.C.S.L, *President.*
Henry William Caird, M.A. } *Vice-*
Robert John Lechmere Guppy, F.L.S., F.G.S. &c. } *Pres'dts.*
James John Day, F.C.S., *Secretary & Treasurer.*

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1863 Henry William Caird, M.A.
1871 Samuel Leonard Crane, M.D.

1873 James John Day, F.C.S.
1867 Louis de Verteuil.
1864 The Hon. Louis Antoine Aimé de Verteuil, M.D.
1871 G. Townshend Fenwick.
1864 Robert Guppy, M.A.
1863 Robert John Lechmere Guppy, F.L.S., F.G.S., &c.
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1864 William Caspar Kelaart, M.R.C.S.L., Corr. Member Z. S., &c.
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1868 Robert Knaggs, M.R.C.S.L.
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1864. Henry Prestoe.
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His Excellency the Honorable Sir Arthur Hamilton Gordon, K.C.M.G.
His Excellency Rawson William Rawson, C.B.
His Excellency James Robert Longden, C.M.G.

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The Hon. Francis Goding, M.D., The Hermitage, Barbados.

Nathaniel Wilson, Jamaica.
Albert C. L. G. Günther, M.A., M.D., Ph. D., F.R.S., &c., British Museum, London, W.C.
Henry J. Krebs, St. Thomas.
Jules François Court, M.D., 4, Rue du Centre, Beaujon, Paris.
Thomas Bland, F.G.S., 42, Pine-street, New-York.
J. J. Bowry, F.C.S., Government Chemist in Jamaica.
Henry Edward Armstrong, Ph. D., F.C.S., Professor of Chemistry at the London Institution.

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*Members are requested to communicate changes of Residence &c. to the Secretary.*

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Societies &c. exchanging Proceedings with the Association.

Smithsonian Institution of Washington.
Lyceum of Natural History New-York.
Boston Society of Natural History.
Society of Arts London.
W. G. Binney.
Temple Prime.
Sociedad de ciencias fisicas y naturales de Caracas.
Royal Northern University of Christiania.

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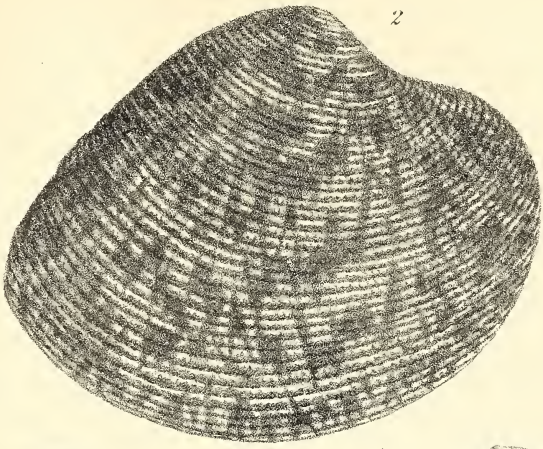
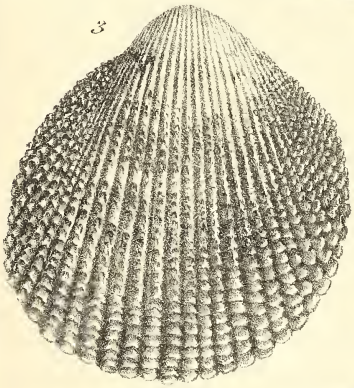
Note on Helicina humilis (H. guppyi Pease).

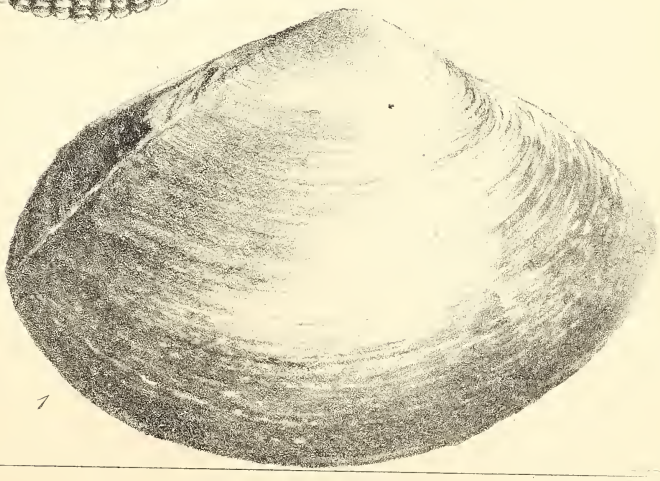
This shell was described from Dominica in the "Annals of Natural History" June 1868, and the name *Helicina*

*humilis* was included in the list of the landshells of Dominica given at page 392 of the 1st vol. of the Proceedings of the Scientific Association.

Pease having found the name *humilis* preoccupied has renamed the Dominican shell *H. guppyi.* (Proc. Zool. Soc. 1871).






J. Susm

WESTINDIAN MOLLUSKA

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## Explanation of Plate III.

*All the figures are of the natural size.*

Fig. 1. *Mactra anserina*, right valve—Cumana, Venezuela.
,, 2. *Venus superba*, right valve ,, ,,
,, 3. *Cardium eburniferum*, right valve–S. Coast, Trinidad
,, 4a *Arca centrota*, right valve, interior.
,, 4b ,, ,, right valve of a large specimen, [exterior.

The last two species were described in the Proceedings of the Scientific Association of Trinidad, vol. i, 1869, pp. 367, 368. *Arca centrota* had been previously described as a fossil at p. 175 of the same vol. (1867).

Presented
24 JUN 1889
NATURAL HIST

24 JUN 1889

PRICE: FIVE SHILLINGS.

# PROCEEDINGS

OF THE

# SCIENTIFIC ASSOCIATION

OF

# TRINIDAD.

PART XI.—DECEMBER 1877.

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# PROCEEDINGS

OF THE

# SCIENTIFIC ASSOCIATION

OF

# TRINIDAD.

PART XI.] DECEMBER 1877. [VOL. II., No. 3.

*Tuesday, 9th May*, 1876.

R. J. LECHMERE GUPPY, Esq., F.L.S., President, in the Chair.

The following Donations were announced:—

"List of the Land and Freshwater Shells of Trinidad. By R. J. Lechmere Guppy, F.L.S., etc. *Presented by the Author.*

"Westindian Tertiary Fossils." By R. J. Lechmere Guppy, F.G.S., etc. *Presented by the Author.*

"Trübner's Literary Record," Nos. 28-113. *Presented by the President.*

The Rev. Henry H. Higgins, Free Public Library and Museum, Liverpool, was elected a corresponding member.

The following was read:—

### Obituary Notice of William Casper Kelaart.

The painful duty of noticing the death of a useful and worthy member of our Society again falls to my lot.

Dr. Kelaart was a native of Ceylon. He arrived in this island in 1848, and was for some time a member of the Government medical staff. He afterwards took up his residence at Sanfernando, where he soon established an extensive practice. He was well known as a most skilful surgeon, and in general practice he was an honest and independent medical adviser. Dr. Kelaart joined our Association soon after its foundation, and continued a firm friend of it until his death, which took place on the 13th October, 1875.

Dr. Kelaart's brother, also lately deceased, was well known as a naturalist.

---

*Wednesday*, 17*th January*, 1877.

R. J. Lechmere Guppy, F.L.S., F.G.S., etc., President, in the Chair.

The following Officers were elected for the current year :—

R. J. Lechmere Guppy, F.L.S., F.G.S., etc., *President.*
Henry William Caird, M.A.
John Edward Tanner, M.I.C.E. } *Vice-Presidents.*
Ernest Francis, F.C.S., *Secretary and Treasurer.*

The following communication was read :—

Proposals *for some improvements in the Town of* Portofspain, *particularly in reference to means of communication.* By

R. J. Lechmere Guppy, F.G.S., President of the Association.

(*Abstract.*)

The author commenced his paper by referring to one read by the Hon. Dr. de Verteuil to the Association in 1867, but he did not propose on the present occasion to go over the same ground as that taken by the learned Doctor.

The author pointed out that Portofspain might be roughly divided into three parts: first, the southern and central portion; secondly, the part to the east of the Dry River; and thirdly, Newtown, the north-western division. In addition, there is on the north-east the growing suburb of Belmont. The town is altogether deficient in anything like a great artery of communication, and this want ought to be supplied. It was proposed to do this by widening certain streets and laying tramways in them, thus connecting the jetty where the steamers lie, and the railway station, with Newtown by way of Tragarete Road, and with Belmont by way of St. Ann Road. The author showed that this might be done at a minimum of expense by adopting certain routes which he described. He proposed that one tram line should run by Tragarete Road up Maraval Road to the corner of the Savana, and that a strip of land on the western side of Maraval Road should be acquired and laid out in building sites. The Tranquillity property lately acquired by the Government would be much increased in value by the proposed tram line, and could be laid out to advantage.

From the terminus of the Belmont line of tramway a new road should be laid out through the San François valley to Santacruz, there being great natural facilities for this purpose.

The author then proceeded to point out several serious defects which existed in the present mode of laying out the streets and side drains, and recommended that pipe drains be tried to supersede the present incommodious and unhealthy open drains, which occupied much of the roadway, and did serious damage to vehicles, besides being expensive to construct and maintain.

The desirability of completing the wharf extension in front of the Bonding warehouses was next alluded to, and it was proposed that the line of railway should be continued along it and along the shore to Chaguaramas, where a wharf, and if necessary, docks, could be constructed. Ships and steamers could then land their passengers and cargo direct into the railway cars, and thus avoid the trouble, expense, and annoyance caused by the increasing shallowness of the water near Portofspain, which, it was stated, would probably in a few years render the harbour almost useless.

The paper was illustrated by diagrams and plans showing the improvements proposed.

---

*Wednesday*, 27*th June*, 1877.

R. J. Lechmere Guppy, F.G.S., etc., President, in the Chair.

The following Donations were announced :—

"Norwegian Catalogue Philadelphia Exhibition, 1876."

"Enumeratio Insectorum Norvegicorum."

"Anden Beretning om Ladegaardstens Hovedgaard."

"Etudes sur les Mouvements de l'Atmosphere."

"On some remarkable Forms of Animal Life from the Deeps of Norway." "Windrosen des Südlichen Norvegens."

*From the Royal University of Norway.*

"Arduvos do Museo Nacional do Rio de Janeiro." *From the Geological Commission of the Empire of Brazil.*

"On the Miocene Fossils of Haiti." By R. J. L. Guppy

"On the Land and Freshwater Molluska of Nicaragua." By Ralph Tate, F.G.S.

"Trübner's Literary Record," Nos. 114-126. *From the President.*

The following communications were read:—

I. On the Physical Geography and Fossils of the Older Rocks of Trinidad. By R. J. Lechmere Guppy, F.L.S., F.G.S., C.M.Z.S., President of the Scientific Association of Trinidad, etc.

1. *General Considerations.*

The older rocks of Trinidad were described by Messrs. Wall and Sawkins in their Report on the Geology of Trinidad under the name of the "Caribean Group." The age of the series was not determined by them, although they surmised it to be of considerable antiquity. The position as well as the lithological structure of these rocks are such as lend strong support to the theory of their great age; but the absence of fossils rendered all attempts futile at a nearer determination.

The series in question occupies a considerable portion of the litoral cordillera of Venezuela, and extends eastward through the north of Trinidad to Tobago. It is composed of gneiss, gneissose, talcose, and micaceous slates and crystalline and compact limestones. The compact limestones however, may possibly be of a much later age than the other portions of the group—they lie unconformably upon the upper beds of the metamorphic slates.

In Trinidad the northern range of mountains is composed of rocks, belonging chiefly if not entirely to the "Caribean Group." These rocks attain collectively a thickness of more than 10,000 feet. The whole thickness of the group is probably much greater than this; for the evidence furnished by dip and other circumstances leads to the inference that a portion of the series, as developed in Venezuela, is inferior in position to any of the rocks exposed in Trinidad. In the diagram, Fig. 3, this older portion is represented as thrown down to the north of Trinidad, beneath the waters of the Caribean Sea (Fig. 3, *a*). Besides this downthrow we have evidence of two or three other lines of dislocation which traverse the range through its length from east to west. These dislocations are marked with a star in Fig. 3, and are indicated on the sketch map, Fig. 1. They have caused, in conjunction with other movements, of which I shall presently speak, some peculiar phenomena in the physical geography of the valleys, which are much narrower, and in some cases quite ditch-like, to the south of the line of the greatest dislocation (between *c* and *d*, in Fig. 3), and widen out above into large basins.

The separation of Trinidad from Venezuela was probably produced by a great downthrow, which I have attempted to represent in Fig. 2. The line of that downthrow, passing through the Boca Grande, is laid down in the sketch map, Fig. 1. From the facts intended to be illustrated by these diagrams, it would appear that the Gulf of Paria occupies an area of depression, the lowest axis of which passes through the Boca Grande, running approximately north and south. The amount of subsidence diminishes gradually as we pass eastward, until at the valley of Arouca its effects disappear

(*see* diagram, Fig. 2). Plain evidences of this remarkable subsidence are to be found in the submerged valleys about the Bocas,—valleys obviously produced by subærial denudation, but now sunk below the level of the sea. Not less clear is the testimony of the wide and comparatively shallow valleys of Carenage and Diegomartin, originally much deeper, but now to a great extent filled up by alluvium. As we go eastward from Diegomartin the valleys become steeper and narrower, assuming the form of mere ditches in their lower portions, but having immense delta-like deposits of alluvium at their mouths, ranging from 80 to 200 feet in height above the level of the Caroni plain. These moraine-like deltas are evidences of upheaval rather than of subsidence; they are not found in the valleys west of Portofspain, but, beginning with the Santacruz valley, they increase in magnitude as we go east.

I have already said that the petrological and physical features of the Caribean group would lead us to assign a high antiquity to it; but the absence of fossils has prevented any precise determination of its age. I shall presently indicate what evidence we have gained on this head, since the publication of the Geological Report on Trinidad.

### 2. *The Fossils of the Caribean Group.*

In 1869 I had communicated to the Geological Society of London my discovery of organic remains in the Caribean Series of Trinidad. I described to that Society a piece of limestone which exhibited unmistakeable marks of organic origin. The specimen in question was a part of an irregular string of limestone, found on digging a trench in the decomposed micaslate in the San François valley, north of the

Laventille Hills. The bulk of the specimen was composed of a calcareous structure which appeared to me to bear a resemblance to the Eozoon of Dawson and Carpenter. There were also fragments of echinoderms and corals. I described the first-mentioned structure under the name of *Eozoon caribeum*, pointing out some obvious differences between it and *E. canadense*. I sent specimens to Dr. Carpenter, who however after a slight examination did not pronounce any definite opinion upon them. He says he treated them with acid; but that operation could scarcely be of much use except where the spaces formerly occupied by the living body were infiltrated with a siliceous deposit. In the present case the infiltration as well as the skeleton itself is calcareous. I should not consider it necessary to insist upon the eozoonal theory in reference to this rock, if evidence hereafter point to the contrary; but I think no doubt can rest upon the organic origin of the whole structure; and I prefer for the present therefore to adhere to the name of *Eozoon caribeum*, though subsequent researches may render it doubtful whether it is congeneric with *E. canadense*.

Besides the fossil which I have regarded as an Eozoon, and of which the greater part of the specimen just described is made up, there are other organisms observable in it. A few small pieces of corals occur. One form I have named *Favosites fenestralis*, a minute species, which probably has its nearest analogue in *F. fibrosa*. No pores or tabulæ are visible in our fossil, whence its identification with Favosites may appear to be doubtful; but I am rather disposed to attribute the absence of those structures to metamorphism.

The remains of echinodermata are distinct enough to allow of our referring them without doubt to that division of

the animal kingdom; but the generic and even the ordinal characters are difficult to make out. There are plates, stems, and spines scattered through the stone; the most perfect consisting of five ambulacral plates and four pairs of pores. Another specimen, though much broken, shows portions of at least twenty ambulacral or pseudo-ambulacral plates, somewhat resembling the Devonian *Eleacrinus*. In some of the calciferous slates from the same series very similar remains occur, but no perfect or nearly perfect specimen has come to hand. Some of the fossils appear to be fragments of cystidea.

There is nothing improbable in the association of serpuline, molluskan, and echinoderm remains with Eozoon. Speaking of the Canadian rocks, Dr. Dawson refers to fragments possessing appearances highly characteristic of crinoidal remains, and mentions that these and other appearances would indicate that in addition to the débris of Eozoon, other calcareous structures more like those of crinoids, corals, and shells have contributed to the formation of the Laurentian limestones.

I give here a list of the fossils I have with more or less certainty identified from the calciferous slates and intercalated limestones of the mica and clay-slates of the Caribean Group. Small as this list may appear, it is a great advance upon anything previously published as to the paleontology of these rocks. It may be noticed that there is no mollusk in the list, nor have I yet seen any fossil from the Caribean Group (exclusive of the compact limestone) which I could refer with any degree of probability to the sub-kingdom molluska.

*Fossils of the Caribean Group.*

? Eozoon caribeum Guppy.
Favosites fenestralis ,,
Petraia (like P. bina Lonsd).
Pseudocrinites (species like Ps. magnificus Forbes).

The other remains have not been assigned with any certainty to their generic positions.

3. *The Blue or Compact Limestone.*

The southern borders of the ranges formed by the Caribean Group are fringed here and there by low hills chiefly of limestone, with occasional interstratified beds of clay-slate and shale, lying unconformably upon the micaschists and clayslates, which constitute the larger elevations. This compact dark-blue limestone, often nearly black, contains abundant fossils, but in so metamorphosed a state as to be generally irrecognizable. We find in some beds what appears to be a mass of serpuline remains, occasionally small univalves show themselves, and rarely a few distinct corals. But the rock is so hard, and the structure of the fossils so altered, as to make it next to impossible to extract any of these organic remains in a state which might admit of study or identification. Consequently we are almost as much in the dark as ever as to the age of these rocks. One important conclusion, however, has been gradually forcing itself upon my mind, which is that the compact blue limestone of Gaspari, Pointe Gourde, the Cotoras, and Laventille does not belong to the same formation as the mica and talc schists and sandstones, the clayslate, quartzite and crystalline limestones of the Caribean Group. The compact limestone is of a later age; for while the Caribean Group appears to belong to an older paleozoic epoch, the compact limestone

may turn out to be newer paleozic or even older secondary. This is perhaps speaking rather widely; but the state of the fossils found so far does not allow of a more definite statement. Professor Tate is of opinion that the whole series is jurassic.

My attention was first called to the fossils of the compact limestone by Dr. Stevens, who was engaged at the gold mines of Venezuelan Guiana. He showed me a piece of limestone containing small gastropods, like Murchisonia (*M. anna* Billings), and small bivalves like Leptodomus. Dr. Stevens was aware that I had already discovered organisms in the clay slates and calciferous slates of the older series. Further search in the blue limestone resulted in my finding a shell differing slightly from Dr. Steven's specimens, and more resembling another North American species of Murchisonia (*M. linearis* Billings). Lately I have discovered at the Cotoras (or Five Islands) a number of specimens of a Turritella-like shell, which, however, I am not able to refer with any certainty to Murchisonia, although there is a possibility that it may belong to that or an allied genus. There was, I thought, a resemblance between the specimens and some of the narrow forms of Nerinea, but I was unable to demonstrate either a hollow axis or folds on the columella. Several specimens also occurred of another and much smaller gastropod (like *Loxonema lincta* Phill. Pal. Foss). Supposing my ideas of the resemblances of these fossils to be somewhere near the truth, the age of the compact limestone might be Devonian or Carboniferous. The corals found associated with the shells are of a massive kind, but I could not detach a fragment. I have been told of the discovery of a heterocircal fish in these rocks, the specimen having

been found in one of the quarries near Portofspain, but I have not seen it. It might throw some light upon the question. Unfortunately, no fossil that I have seen is sufficiently decided in its characters for me to pronounce more certainly upon the subject. The discovery of a trilobite, a graptolite, or an ammonite, would relieve us from a great deal of perplexity, and I feel great faith that some such evidence will be forthcoming eventually.

Some of the beds of the blue limestone have a strong resemblance to certain varieties of oolite. A section of this exhibits a number of very closely packed elongate-oval opaque-grey grains, embedded in a darker material. When this rock is weathered, the grains are dissolved out and the intermediate material remaining bears a resemblance to Stromatopora or Eozoon.

*Organic Remains from the Blue Limestone.*

? Murchisonia, two or three species. Leptodomus species.
? Loxonema species.
also a massive reef-coral and many serpuline fossils.

## II. On the Discovery of Tertiary Coal at Williamsville, Savanagrande. By R. J. Lechmere Guppy, F.L.S., F.G.S., etc.

*Preliminary Notice.*

A short account of the Coal Bed discovered at Williamsville may be of interest to the members of the Association. A visit to the spot where the bed is being worked enabled me to take a few notes with respect to it.

The site of the discovery is on the Montserrat road, about half a mile from the railway between Union and Brothers. The workings are in the valley along which the road runs. The seam is from four to five feet thick, and the coal is apparently of fair quality, but so extremely friable that it falls on handling into very small pieces. This property is prejudicial to the value of the article.

The dip of the bed is between 50° and 60° to the W.N.W., consequently the strike is about N.N.E. The containing strata are clays without fossils, probably belonging to the upper part of the miocene (*h*, Fig. 3), lying unconformably upon the secondary rocks. The strata are probably the equivalents of the Caroni series (*h''*, Fig. 3), but they are deposited on the opposite (southern) side of the neocomian ridge which traverses the middle of the island. Our knowledge of the geological structure of this part of the country is extremely deficient owing to the want of exposures, without which no geologist could ascertain with precision the position and relations of the rocks. In Fig. 3 I have endeavoured to present an improved view of the succession of the rocks of Trinidad, based upon the results of the geological survey; but with such improvements as observations extending over fifteen years have enabled me to suggest. In this diagram *h*, *h'*, *h''*, and *h'''* represent the miocene or tertiary coal-bearing formations, which probably pass up near the south coast into pliocene beds, which also include lignite and carbonaceous shales. The extent of the eocene formation is not clearly defined; this formation does not contain beds of lignite so far as known, but many of its beds are impregnated with asphaltic products, which in my opinion are derived from the miocene formation.

There can be no doubt of the existence in the Caroni carbonaceous series (Miocene) and its equivalents both to the north and to the south of the central ranges of extensive deposits of tertiary coal which will sooner or later be of much value to the island. The seam which is the subject of this paper is not at present worked to a greater depth than eight or ten feet, owing to the influx of water, which cannot easily be drained off, but would require engine power if the pits are carried much deeper. Moreover, the clays cave in, and would require appliances such as are generally used in mining operations to keep the pits open. But as the seam runs into the hill a greater depth of it will at every step be available without serious hindrance from water, provided proper means be used to prop the working and prevent caving in.

Want of time and opportunity prevents me at present from following up this subject more closely, but I trust hereafter to be able to pay some attention to it.

I have seen specimens of coal from other seams in the Montserrat district, which, owing to their less friable nature, will probably prove to be of higher value. The Williamsville coal may prove useful for making gas, and also for smithy purposes; but to be adapted for general purposes without waste it would have to be manufactured into a form similar to the so-called "patent fuel." In any case, however, the precise value of the article must be determined by experiment, for it is difficult to pronounce upon its exact qualities by inspection only. A reference to the geological map will show that the existence in the neighbourhood of the Guaracara of deposits of asphalt and petroleum has already been indicated; and some recent discoveries of glance asphaltum

in quantity may possibly lead to the opening up of a new branch of productive industry in the island.

The quantity of rocks in this island yielding asphaltic and bituminous substances which may hereafter be valuable for the production of illuminating and other oils by distillation is very great. Tertiary coal was discovered and worked in Couva many years ago. The site of the beds is marked on the geological map, and they probably extend with more or less interruption all across the island to the north of the Tamana and Montserrat ranges. I append hereto an extract from a report on the Couva coal by Mr. Wall, Director of the Geological Survey.

The late discoveries added to my own observations make it seem probable that the Nariva series of the Government geologists, is the equivalent on the south side of the central range of the Caroni carbonaceous series on the north; and if this be correct, we may expect to find a series of coal beds extending from the Guaracara valley on the west to the Nariva swamp on the east. In support of this view I may state that the section made by the Geological Survey of the country between Sanfernando and Montserrat bears out the theory of the contemporaneity of the so-called Nariva series with the Miocene (Caroni) series.

*Extract from a Report by* G. P. Wall, F.G.S., *Director of the Geological Survey, on the Mineral Fuels of the Couva District, dated "Trinidad, 1st May,* 1857."

The deposits of mineral fuel in the district of Couva, consist of carbonaceous beds of a character intermediate between lignite and coal. A practical trial of the economic value of this substance was made by Mr. Maurice Rostant, who was

perfectly satisfied that if a quantity could be obtained it would be of great use in the operations of the sugar works, although, from the proximity to the surface, and the consequent exposure to atmospheric and aqueous deterioration, the specimens employed must have been much inferior to that existing at a depth. The only beds at present known—three in number—are intersected by the Savanetta river on the Caracas estate. The thicknesses are twenty inches for the upper and twelve inches each for the two lower seams. They are associated with clays, sands, and peculiar blue and grey shales, which repose on an extremely ferruginous stratum, under which are the limestones and calcareous sandstones of the Montserrat hills, near the base of which range the strata in question are situated. Proceeding north towards the plain of Couva, the carboniferous clays and shales are soon covered with loose sands, so that their extension in this direction is at present indeterminate. The section (Fig. 4) illustrates the stratigraphical relations just described.

In mineral character, these beds of lignitic coal bear considerable resemblance to specimens of a similar substance discovered at Pointe Noir; and the geologists have ascertained that both belong to the same formation, which extends, as described in their Report, across the island.

In passing from the centre of the ridge (in the vicinity of Tamana) to the Caroni, the sequence showed in Fig. 5 was observed. In this section there is a much greater development of the same ferruginous stratum as exists at Couva; but one passes directly from it to the sands, without traversing any intervening clays or shales. If then the carboniferous series exist there they must be concealed by the greater extent and thickness of the sands in this locality.

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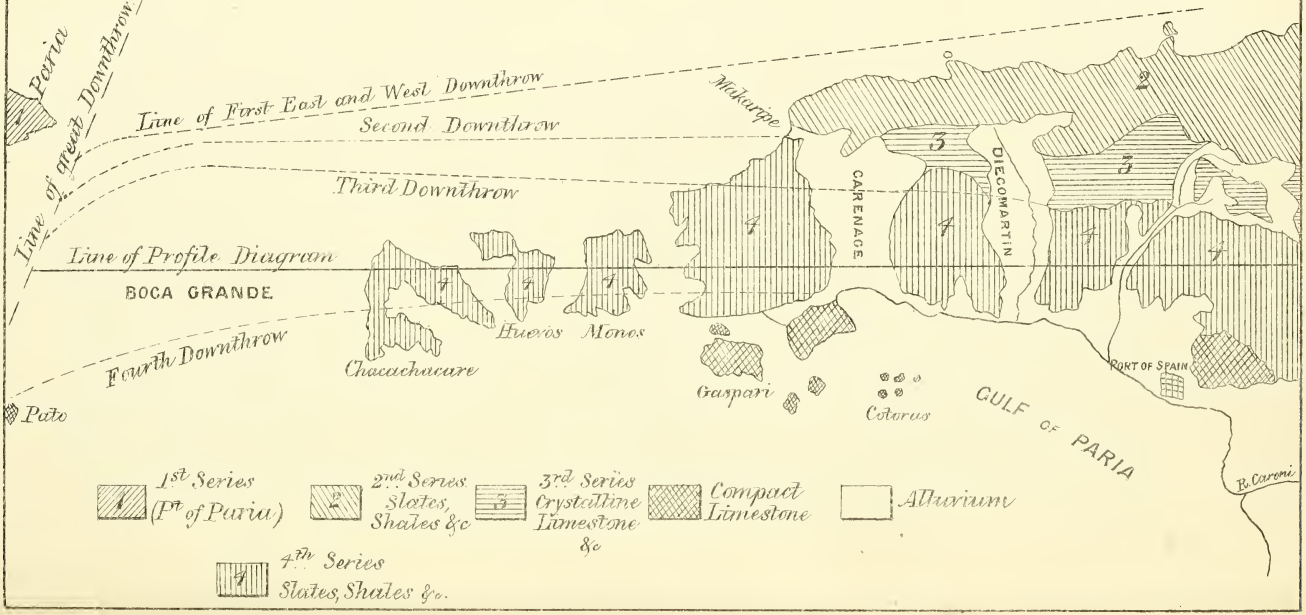
*Fig. 1. Sketch Map of the North Western Part of Trinidad showing the Lines of the principal Dislocations.*



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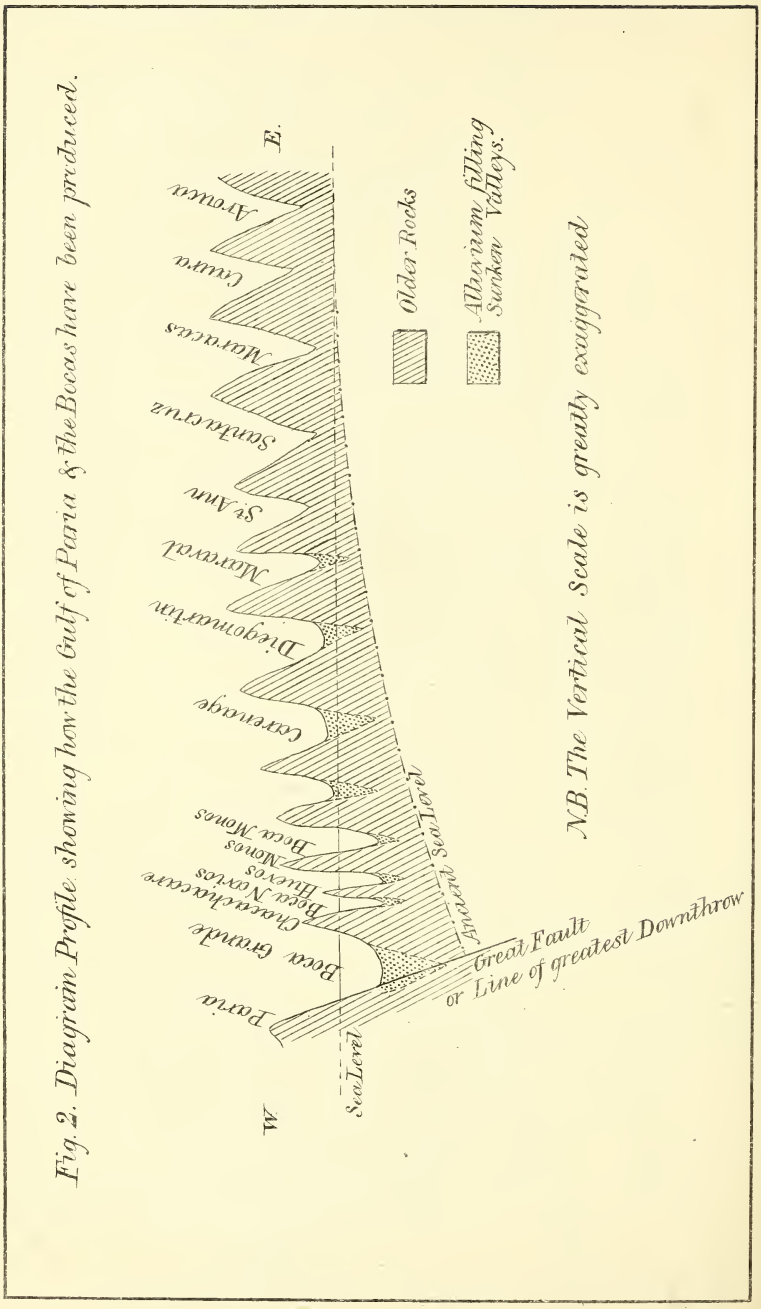


*Fig. 2. Diagram Profile showing how the Gulf of Paria & the Bocas have been produced.*

NATURAL HISTORY.

*Fig 3 Diagram Section showing the General Succession of the Rocks in Trinidad*

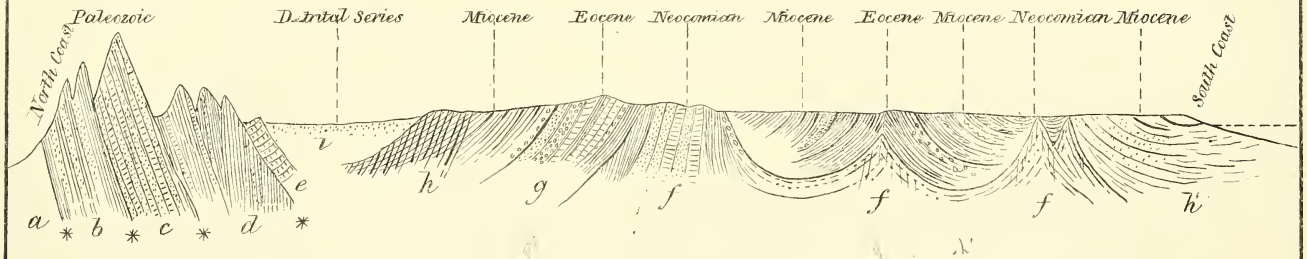

*Fig. 4. Section of Carbonaceous Series at Couva.*

*a. Montserrat Limestone. b. Ferruginous stratum.*
*c. Clays, Shales &c. d. Beds of Tertiary Coal.*
*e Extension of Miocene Series. f. Sands.*

*Fig. 5. Section near Tamana*

*a. Montserrat Limestone. b. Conglomerate.*
*c. Ferruginous Stratum. d Sands.*

### Explanation of Diagram.

Fig. 1 shows approximately the lines of the principal dislocations which have affected the older rocks of Trinidad, and produced the Gulf of Paria and the Bocas.

Fig. 2 is a diagram showing the probable extent of the subsidence by which the Bocas and Gulf of Paria were produced.

Fig. 3 shows the general succession of the rocks of Trinidad—*a b, c, d,* Caribean Group; *e,* compact limestone; *f,* secondary rocks; *g,* eocene of Tamana and Manzanilla; *g′,* eocene of Sanfernando; *h,* miocene of Guaracara; *h′,* miocene of South Naparima: *h″,* miocene, of Couva, Savanetta, Pointe Noir, etc.; *h‴,* miocene and pliocene of Moruga, Mayaro, etc.; *i,* post pliocene or detrital series.

* Principal dislocations or faults.

Figs. 4 and 5 are referred to in Mr. Wall's report.

## III.—On Cassava. By Ernest Francis, F.C.S.

It is well known that two species of the euphorbiaceous plant manioc or cassava are said to exist; one of which, called bitter cassava, possessing poisonous qualities, is avoided in its fresh and dangerous condition; while the other, or sweet cassava, being considered harmless, is largely used as food in its natural state.

The noxious properties of bitter cassava have been commented on by numerous medical and toxicological historians since the time of Piso, who in the middle of the seventeenth century mentioned, together with other facts, the toxic powers of the *radix mandihoca:* the true nature of the poison, however, became established only at a much later date.

In 1796, Dr. Clarke of Dominica, describing the fatal effects resulting to negroes from drinking half-a-pint of the

juice of bitter cassava, compared the action of the poison to that of prussic acid; and Dr. Fermin, in a memoir communicated to the Academy of Berlin, concerning experiments made at Cayenne upon the juice of the manioc, showed that the poison was volatile and could be isolated by distillation. He gives particulars of an experiment in which fifty pounds of the fresh juice yielded by distillation three ounces of a poisonous liquid of most offensive odour, thirty-five drops of which being administered to a criminal slave, caused his death in six minutes, amid horrible convulsions.

Subsequently, MM. Henry and Boutron-Charland, by an examination of juice imported into France, identified in it the presence of prussic acid, and also found the effects produced on animals indicated that poison (*Mem. de l'Acad. de Med.*, v., 212). In 1838, Dr. Christison confirmed this discovery in some well-preserved juice from Demerara (*On Poisons*, 4th edit., p. 591).

Notwithstanding this early identification of the poison, no attempts appear to have been made to determine the quantity of the poisonous acid yielded by the plant. The present writer, therefore, undertook an experimental inquiry into the subject, not only because it offered a certain intrinsic interest, but also because occasions may arise when a knowledge of the quantity of cassava likely to cause death might be important from a medico-legal aspect.

The investigation ultimately extended to both kinds of the plant, and resulted in the discovery of the singular fact that the so-called sweet or harmless cassava not only yielded prussic acid, but the quantity obtained from it so nearly equalled that from the bitter that no line of distinction could be drawn between them.

These results are recorded in a paper—"On Prussic Acid from Cassava"—published in the London *Analyst* for April, 1877, which included the following table, showing the amount of prussic acid yielded by a number of different samples of bitter and sweet cassava; the quantities being given in percentages and also as grains of prussic acid from an avoirdupois pound of the fresh root.

TABLE I.

QUANTITY OF PRUSSIC ACID YIELDED BY CASSAVA ROOTS.

| | Sweet. | | | Bitter. | |
|---|---|---|---|---|---|
| No. of Sample. | Per cent. of H C N. | Grains of H C N per lb. | No. of Sample. | Per cent. of H C N | Grains of H C N per lb. |
| i. | ·0158 | 1·106 | i. | ·0377 | 2·639 |
| ii. | ·0121 | 0·847 | ii. | ·0237 | 1·659 |
| iii. | ·0125 | 0·875 | iii. | ·0442 | 3·094 |
| iv. | ·0133 | 0·931 | iv. | ·0440 | 3·080 |
| v. | ·0113 | 0·791 | v. | ·0132 | 0·924 |
| vi. | ·0194 | 1·358 | vi. | ·0209 | 1·463 |
| vii. | ·0226 | 1·582 | vii. | ·0348 | 2·436 |
| viii. | ·0199 | 1·393 | viii. | ·0221 | 1·547 |
| ix. | ·0208 | 1·456 | ix. | ·0133 | 0·931 |
| x. | ·0238 | 1·666 | x. | ·0215 | 1·505 |
| xi. | ·0202 | 1·414 | | | |
| xii. | ·0134 | 0·938 | | | |
| xiii. | ·0202 | 1·414 | | | |
| xiv. | ·0149 | 1·043 | | | |
| xv. | ·0117 | 0·819 | | | |
| Mean | ·0168 | 1·175 | Mean | ·0275 | 1·927 |
| Highest | ·0238 | 1·666 | Highest | ·0442 | 3·094 |
| Lowest | ·0113 | 0·791 | Lowest | ·0132 | 0·924 |

The samples indicated in the table were obtained from as many sources as possible; some from stalls in the public markets, others direct from the different cultivators, pains being taken to avoid substitution of one kind for the other.

To separate the prussic acid from cassava in a form adapted for estimation, distillation was essential, but the 30 per cent. of starch which the roots contain had to be excluded from the retort. In order to accomplish this

exclusion and at the same time insure a correct determination of prussic acid, a special mode of operating had to be adopted. A description of the process used is therefore reproduced from the above-mentioned paper.

Five hundred grammes of the root were quickly grated into 500cc. of water. The mixture was allowed to stand in a well-closed vessel for about two hours, and the liquid was then squeezed through a linen cloth into a flask. The flask being corked, the starch was allowed to deposit, and then 200cc. of the upper portion of the liquid were decanted and distilled. The retort was connected by a caoutchouc joint to the condenser, the end of which dipped beneath the surface of water made alkaline with soda, and contained in a closed receiver.

The quantity of prussic acid found in the 200cc. of liquid represented one-fourth of that actually present. This estimate is arrived at in the following manner: both bitter and sweet cassava were found by a number of determinations to contain close upon 60 per cent. of water. The 500 grammes of root taken, therefore, would furnish, approximately, 300cc. of water, which, augmented by the 500cc. added, would make an aggregate of about 800cc. All the prussic acid yielded by the sample would of course be found in solution in this quantity of liquid. The amount present in the 200cc. removed would thus represent $\frac{200}{800}$, or one-fourth of the total quantity.

The prussic acid in the alkaline distillate was estimated either volumetrically or by precipitating and weighing as silver cyanide. The results were occasionally verified by combining the methods—first determining the prussic acid by volumetry, then adding excess of the silver solution to the

same portion, acidifying with nitric acid, and collecting and weighing the silver cyanide produced. Fairly concordant results were thus obtained, as shown by the following average examples.

I. *Prussic Acid from Sweet Cassava.*

| | Per cent. of H C N. | Grains of H C N per lb. |
|---|---|---|
| Volumetric method ... ... | ·01992 | 1·3944 |
| Gravimetric „ ... ... | ·01924 | 1·3468 |

II. *Prussic Acid from Bitter Cassava.*

| | Per cent. of H C N. | Grains of H C N per lb. |
|---|---|---|
| Volumetric method ... ... | ·02090 | 1·4630 |
| Gravimetric „ ... ... | ·01996 | 1·3972 |

the higher results furnished by volumetry doubtless showing the usual error arising from the slight excess of standard solution required to indicate the completion of the process. The silver solution used was nominally decinormal, but its exact strength was fixed with care.

During the grating of the cassava, which occupied about five minutes, a slight loss of prussic acid was made evident by its odour. Nevertheless, this was certainly too small to seriously affect the correctness of the determinations, since the quantity of prussic acid found in the normal juice seldom exceeds one part in two thousand of liquid, and such dilute solutions bear moderate exposure without being sensibly altered. Estimations, made at intervals, of the prussic acid in the diluted juice, showed that it suffered no apparent loss during two hours while standing in a loosely-covered beaker; but a loss of about one-tenth was found after sixteen hours. When fermentation was in progress, the prussic acid soon diminished, and in six days became reduced to one-fifth of the original quantity.

The juice, although at first nearly neutral, quickly becomes acid, and was always so at the time of distillation. In some of the earlier experiments sulphuric acid was added to the contents of the retort, usually after all the free prussic acid had passed over; but the yield was not found to be influenced by this treatment.

The high temperature prevailing in this climate rendered it necessary to prove that prussic acid could be isolated by distillation from dilute solutions without loss. Aqueous prussic acid, therefore, was prepared, and diluted until 20cc., made up to 200cc. with water, would furnish a solution containing about twice the quantity found in the liquid strained from the roots. Two such mixtures having been made, the prussic acid in one was estimated directly, and in the other after distillation. The following results were obtained —

*H C N in* 200*cc. of Solution.*

| | | |
|---|---|---|
| I. | Not distilled ... ... ... | ·06824 grm. |
| II. | Distilled ... ... ... ... | ·06744 „ |

Corrected temperature of water passing from condenser, 25·2°c.; of laboratory, 27°c.; this temperature being usual.

A second trial was made by diluting 20cc. of the same prussic acid to 500cc. Two portions of 200cc. were measured, and the prussic acid in each estimated as before.

*H C N in* 200*cc. of Solution.*

| | | |
|---|---|---|
| I. | Not distilled ... ... ... | ·02734 grm. |
| II. | Distilled ... ... ... ... | ·02726 „ |

A final experiment determined whether a known quantity of prussic acid, added to the *diluted juice*, suffered loss by distillation. The juice used had not been distilled, or deprived of the prussic acid naturally present, but this was

estimated by a separate experiment and allowed for. The usual quantity was taken, and 100cc. of prussic acid, which had been found to contain ·02599 gramme of H C N, were added. The mixture was distilled.

| | | |
|---|---|---|
| Total H C N by distillation | ... | ·03447 grm. |
| H C N natural to juice ... | ... | ·00951 „ |
| H C N recovered ... | ... | ·02496 „ |

TABLE II.

PERCENTAGE OF WATER FOUND IN CASSAVA ROOTS.

| No. of Sample. | Sweet. Per cent. of $H_2O$. | No of Sample. | Bitter. Per cent. of $H_2O$. |
|---|---|---|---|
| i. ... ... | 58·73 | i. ... ... | 59·40 |
| ii. ... ... | 58·33 | ii. ... ... | 60·80 |
| iii. ... ... | 59·13 | iii. ... ... | 61·80 |
| iv. ... ... | 61·31 | iv. ... ... | 61·24 |
| v. ... ... | 58·25 | v. ... ... | 62·07 |
| vi. ... ... | 60·65 | vi. ... ... | 67·79 |
| Mean... ... | 59·40 | Mean... ... | 61·35 |

* * * *

Although every author consulted by the writer is agreed in classifying cassava as either harmless or noxious, several discard the notion of the existence of different species, urging that the variations exhibited are too insignificant to permit of any distinction of the kind.

Thus, a recent writer, M. Paul Sagot, in an article on the manioc or tapioca plant, (*Pharm. Journ.*, 3rd series, iii., 569), says:—"Pohl describes the sweet (non-poisonous) *manihot* (called *aïpi* in Brazil; *m. aïpi*, Pohl.) as a distinct species from the poisonous *manihot* (*yuca brava*, or *mandioca brava*, of the Spanish and Portuguese Colonies;) but the author agrees with Goudot in thinking that they are only varieties of the same species."

Dr. Christison in his treatise on poisons has the following : "The *janipha manihot* or cassava plant has two varieties, one of which produces a small spindle-shaped bland root, called in the West Indies sweet cassava, while the other has a much larger, bitter, poisonous root, called bitter cassava."

Dr. Taylor states that "the root of one variety of this West Indian plant, known under the name of bitter cassava, contains in its juice prussic acid."

Dr. Hamilton, for many years resident in the West Indies, in one of an interesting series of articles on West Indian medicinal plants, which he contributed to the earlier numbers of the *Pharmaceutical Journal*, writing of sweet cassava, says (*Pharm. Journ.*, vol. v., p. 31) :—"The *janipha læfflingii* so closely resembles the former (bitter cassava) in its external characters, that it can hardly be distinguished with certainty by even an experienced eye, and has been considered by Browne and many other writers merely as a variety. Its root, however, is wholly destitute of the active principle which renders the bitter cassava in its unprepared state an object of such just apprehension ; the roots of the sweet cassava requiring no other preparation than simply boiling or roasting, and even admitting of being eaten raw with impunity."

The above extracts are sufficient to show that the distinction hitherto made between bitter and sweet cassava depends far less upon external characteristics than upon the assumed presence or absence of the noxious principle which we now know to be prussic acid. That a certain variation is exhibited in the mode of growth of cassava is a well-known fact, but the preceding experiments prove that the presence of the noxious principle is not confined to one kind of the

plant. Presuming, then, that the sweet cassava obtainable in this island is a true type of the kind so called, the existence of a harmless cassava is disproved, and the term "sweet" ceases to be significant.

Dr. Clark's observation, that half a pint of the juice of bitter cassava was sufficient to destroy life, has been recorded above. That his statement is correct is evident from the writer's experiments, since half a pint of the juice, or, more exactly, 9·6 ounces, represents one pound of the root; and it will be seen on reference to the table that this quantity of bitter cassava yields on the average 1·92 grains of prussic acid. On the other hand, an equal quantity of the juice of sweet cassava yields on the average 1·17 grains,—an amount also sufficient to produce fatal effects.* Moreover, fifty per cent. of the samples of sweet cassava yielded considerably more than this proportion.

From some further experiments made by the writer, it appears probable that sweet cassava develops increased poisonous qualities with age. During last month a singular and undoubtedly old specimen of sweet cassava was examined. Many of the roots were of large size and almost globular in shape, and they were said to have remained in the ground for more than a year. This sample yielded ·0352 per cent. of prussic acid, or a quantity equal to no less than 2·464 grains per pound. An amount of juice equivalent to three pounds of the root of this sample yielded by distilla-

* Dr. Taylor fixes the poisonous dose of prussic acid at one grain, but at the same time reports the case of a healthy woman who died in twenty minutes from a dose equivalent to nine-tenths of a grain of anhydrous prussic acid (*On Poisons*, p. 594). Dr. Wormley states that the above seems the smallest fatal quantity yet recorded (*Micro-Chemistry of Poisons*, p. 172).

tion 36·34 grains of cyanide of silver, which, being decomposed with hydrochloric acid, furnished the specimen now laid before the Association, consisting of $6\frac{1}{2}$ fluid drachms of prussic acid of British Pharmacopœia strength, or a quantity sufficient to destroy the life of six adults.

In a future paper the writer proposes to bring before the notice of the Association certain facts relating to the influence of boiling on cassava, and the consequent destruction and dissipation which the prussic acid contained in it suffers.

The following proximate analyses will serve to show the relative compositions of bitter and sweet cassava. Others could be given which approximate more closely, but these have been selected as representing typical specimens of the plant.

*Percentage composition of "Bitter" and "Sweet" Cassava.*

| Bitter Cassava. | | Sweet Cassava. | |
|---|---|---|---|
| Water ... ... | 62·07 | Water ... ... | 58·73 |
| Sugar ... ... | 2·67 | Sugar ... ... | 0·81 |
| Starch ... ... | 29·39 | Starch ... ... | 33·38 |
| Fibre... ... ... | 2·01 | Fibre... ... ... | 2·04 |
| Salts ... ... ... | 0·59 | Salts ... ... ... | 0·71 |
| Fat, albumen, etc. ... | 3·27 | Fat, albumen, etc. ... | 4·33 |
| | 100·00 | | 100·00 |
| Per cent. of prussic acid ... | ·0442 | Per cent. of prussic acid ... | ·0238 |
| „ „ nitrogen ... | ·0889 | „ „ nitrogen ... | ·0887 |

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*Wednesday, September 19th*, 1877.

R. J. Lechmere Guppy, F.L.S., etc., President, in the Chair.

The following Donation was announced:—

"Address of the President (Prof. P. M. Duncan) to the

Anniversary Meeting of the Geological Society, 1877." *Presented by the President.*

The following communications were read:—

I. On a Chemical Examination of Specimens from the recently discovered Coal Deposits at Williamsville and Montserrat. By E. Francis, F.C.S.

1. *The Williamsville Mineral.*

The geological conditions under which this mineral occurs have been fully described in a paper by the President of this Association (On the Discovery of Tertiary Coal at Williamsville, Savanagrande, by R. J. Lechmere Guppy, F.G.S., F.L.S., Proc. Scien. Assoc. Trin., 1877, p. 110), at whose request the following chemical examination was undertaken, and who kindly furnished the necessary specimens.

In laying the results of the investigation before the meeting, it must first be mentioned that the assignment of the term "coal" to this mineral is incorrect, for although it resembles coal in appearance, it proves to be a variety of asphalt or bitumen.

The chief physical characters of the mineral are as follow:—

It is very brittle, being easily disintegrated by pressure between the fingers. Its fracture is irregular, but somewhat laminated, the broken surfaces having a bright and coal-like lustre. The fine powder is black, with a reddish tinge. Before the blowpipe, it intumesces and burns with a smoky flame, leaving a porous fragile cinder difficult to calcine. Heated in an open basin, it swells up to many times its bulk, forming a porous plastic mass which decomposes and gives

off inflammable gas. A large increase of volume also takes place when it is heated in a tube. The ash is light in colour, and appears to consist chiefly of yellow clay.

The mineral is completely soluble in bisulphide of carbon, benzol, chloroform and in warm oil of turpentine, and forms with these solvents a black varnish which on exposure dries up to a brittle residue of great brilliancy. It is also partly soluble in rock oil. Boiled with alcohol, the latter becomes yellow, and on evaporation deposits a small quantity of yellow oily matter. The residue, after extraction with alcohol, partly dissolves in ether, forming a reddish brown solution exhibiting a strong bluish-green fluorescence, and yielding on evaporation a dark residue of tarry consistence. Boiling solutions of potash and potassium carbonate, even when concentrated, do not apparently dissolve or change the substance.

The melting-point of the mineral could not be determined, since it never becomes actually fluid under the influence of heat. Moreover, it bears without visible alteration a temperature far exceeding the melting-point of ordinary hard asphalt, namely, 100°C. Fragments, placed in a tube immersed in a bath of heated oil of vitriol, only showed incipient softening at 265°C, and little or no further change was produced even when the boiling-point of the oil of vitriol had been exceeded, and a temperature of 340°C reached—this being the greatest heat a mercurial thermometer can be subjected to with safety.

Quantitative operations gave the following results :—

| | |
|---|---|
| Specific gravity ... ... ... ... | 1·1482 |
| Weight of cubic foot ... ... ... ... | 71·597 lbs. |
| Space occupied by solid ton ... ... ... | 31·000 cub. ft. |

PROXIMATE COMPOSITION.

| | |
|---|---|
| *Volatile matters*— | |
| Hydrocarbons | 59·035 |
| Water | 0·664 |
| *Fixed matters*— | |
| Ash | 3·294 |
| Coke | 37·007 |
| | 100·000 |

ULTIMATE COMPOSITION.

| | |
|---|---|
| Carbon | 76·463 |
| Hydrogen | 7·663 |
| Nitrogen | 1·753 |
| Oxygen | 6·349 |
| Sulphur | 3·814 |
| Ash | 3·294 |
| Water | 0·664 |
| | 100·000 |

Calorific equivalents for 100 of mineral—

| | |
|---|---|
| Carbon | 617821 heat units. |
| Hydrogen | 236753 „ „ |
| | 854574 „ „ |

Purified illuminating gas evolved from one ton of mineral—

| | |
|---|---|
| Expt. i. | 9887·9 cubic feet. |
| „ ii. | 10248·3 „ „ |

| | |
|---|---|
| Ammonia corresponding to nitrogen in one ton of mineral | 47·680 lbs. |
| Equal to ammonium sulphate | 224·777 „ |
| Sulphur as calcium sulphate in ash | Trace. |
| Total sulphur | 3·814 per cent. |

The above analytical results show this mineral to be a fairly pure variety of compact asphalt or glance pitch. Although in ultimate composition coal and asphalt are closely allied, their behaviour under the action of heat and solvents

is widely different. In appearance this mineral is deceptive, owing to the absence of the conchoidal fracture, bituminous odour and resinous aspect characteristic of ordinary asphalt; its true nature, however, is revealed by its perfect solubility in various menstrua.

Its indifference towards heat is remarkable, and is probably owing to a deficiency of the lighter or more volatile constituents. Boussingault has shown that asphalt consists of a fixed principle called *asphaltene*, and a volatile one, *petrolene*. By keeping asphalt at a temperature of 250°C for forty-eight hours the volatile portion is driven off, and asphaltene remains as a black solid substance, which becomes soft and elastic at about 300°C, and decomposes before it melts (Watts, *Dict. of Chem.*, i., 426). It will be seen that the Williamsville mineral closely resembles asphaltene, and is probably an analogous or identical product formed by a natural process.

The presence of sulphur in the mineral to the extent of 3·814 per cent. is a notable fact.* It appears to exist in the free state, and not in the form of pyrites (so universal in coal), because the ash was not found to contain the requisite amount of iron. The existence of sulphur in asphalt has not been recorded in any of the published analyses that have

* The determinations of sulphur were made with great care, and two distinct methods were employed. By one the mineral was oxidised in the wet way with nitric acid and potassium chlorate, and by the other it was burnt with potassium nitrate and sodium carbonate. The resulting sulphuric acid was precipitated as barium sulphate. After being collected and weighed the precipitate was purified by heating with hydrochloric acid, and was then well washed and re-weighed, according to the directions of Fresenius.

Blank experiments were also performed with all the materials, and proved their complete freedom from sulphur contamination.

been consulted, but from its frequent contiguous occurrence with asphaltic deposits in Trinidad it is likely to prove a common impurity.

It must further be pointed out that the unusual brittleness of the mineral is probably caused by this ingredient, for it is stated that sulphur added in the proportion of about 1 per cent. to asphaltic mastic makes it very brittle (*Ure's Dict.* 6th edit., i., 238). If sulphur thus modifies the cohesion of asphalt, the determination of its presence or absence in a sample will become a matter of importance.

Although the Williamsville mineral would form but an inefficient substitute for coal as fuel, it might be advantageously employed for the manufacture of illuminating gas. The gas obtained from it appears to be of excellent quality, as a rough experiment will prove. Moreover, the yield is considerable, being about 10,000 cubic feet per ton,—a quantity unsurpassed by many of the best gas coals of Great Britain. The following table by Hughes will show that this statement is not exaggerated.

TABLE I.

QUANTITY OF ILLUMINATING GAS YIELDED BY BRITISH COALS.

| NAME OF COAL. | Cubic feet per ton. |
|---|---|
| Newcastle, aver. 10 samp. ... ... ... ... | 11336 |
| Wigan Cannel... ... ... ... ... ... | 9500 |
| Scotch Parrot... ... ... ... ... ... | 9500 |
| Lesmahago Cannel ... ... ... ... ... | 11312 |
| Ince Hall Cannel ... ... ... ... ... | 11400 |
| Boghead Cannel ... ... ... ... ... | 15000 |
| Derbyshire ... ... ... ... ... ... | 9400 |
| Derbyshire, soft, 3 samp. ... ... ... ... | 7166 |
| Neath, South Wales ... ... ... ... ... | 11200 |
| West Bromwich, (Parliamentary return, Birmingham Gas Co.) ... ... ... ... ... | 6500 |
| Staffordshire, aver. 4 samp. ... ... ... ... | 10467 |

## II.—The Montserrat Coal.

[This paper consists essentially of the analytical report on the qualities of the Montserrat coal, furnished to J. E. Cipriani, Esq., Mayor of Portofspain, on whose estate the deposit occurs.]

*Physical Characters.*—The coal is hard, compact and somewhat brittle, but does not easily pulverise. The fracture is bright and irregular, and sometimes conchoidal. Small quantities of earthy matters and pyrites frequently occur between the layers.

The coal readily ignites under the action of the blow-pipe and burns with much flame and smoke, but with slight intumescence and little caking. The burning fragments retain their shape until converted to ash. The ash is red-grey in colour, and does not fuse. The coal powder is black, with a brownish tinge, and communicates a light yellow colour to caustic potash solution.

| | |
|---|---|
| Specific gravity of coal ... ... ... ... | 1·2874 |
| Weight of cubic foot ... ... ... ... | 80·44 lbs. |
| Space occupied by solid ton ... ... ... | 27·84 cub. ft. |
| Probable stowage space required for ton of loose coal ... ... ... ... ... ... | 41·29 „ |

The proximate analysis of the coal gave the following percentage results:—

| | |
|---|---|
| *Volatile Portion*— | |
| Water ... ... ... ... ... ... ... | 3·666 |
| Hydro-carbons ... ... ... ... ... | 47·188 |
| *Fixed Portion*— | |
| Ash ... ... ... ... ... ... ... | 7·468 |
| Coke ... ... ... ... ... ... ... | 41·678 |
| | 100·000 |

The ultimate analysis showed the following composition :—

| | Dried Coal. | Undried Coal. |
|---|---|---|
| Carbon ... ... ... ... ... | 69·643 | 67·090 |
| Hydrogen... ... ... ... ... | 5·535 | 5·332 |
| Nitrogen ... ... ... ... ... | 2·539 | 2·446 |
| Oxygen ... ... ... ... ... | 10·577 | 10·193 |
| Sulphur ... ... ... ... ... | 3·954 | 3·805 |
| Ash ... ... ... ... ... | 7·752 | 7·468 |
| Water ... .. ... ... ... | 0·000 | 3·666 |
| | 100·000 | 100·000 |

Calorific equivalents of carbon and hydrogen in 100 parts :—

i. Dried Coal ... ... ... ... 707259 heat units.
ii. Undried Coal ... ... ... 680448 „ „

Estimated practical calorific effect, based on the results of the Admiralty inquiry into heating power of coals :—

Quantity of feed water at 100°C converted into steam by 100 lbs. of undried coal ... ... = 750 lbs.
Purified illuminating gas yielded by one ton of coal measured at 28°C ... ... ... ... 5613 cub. feet.
Ammonia equal to nitrogen in one ton of coal ... 69·06 lbs.
Equal to ammonium sulphate... ... ... ... 268·10 „
Sulphur present as pyrites in coal ... ... ... 3·912 per cent.
Sulphur present as calcium sulphate... ... ... 0·048 „ „
Total sulphur ... ... ... ... ... ... 3·960 „ „
Sulphur dioxide gas produced by burning one ton of coal ... ... ... ... ... ... 175·28 lbs.

The foregoing results show that this coal is allied to the class of brown coals described by Messrs. Wall and Sawkins as of middle tertiary formation (*Geolog. Rep. Trinidad*). Although inferior to coal of an earlier era, it will doubtless form a valuable fuel. It approaches perfect coal perhaps more closely than any of the Trinidad specimens yet examined,—a conclusion which has been arrived at by com-

paring its percentage composition with that of the best specimen reported on by Sir R. I. Murchison, namely, the sample numbered 18, from Point Noir (*Geolog. Rep. Trinidad*). But to compare the composition of different specimens of coal, the adventitious and variable constituents, water, sulphur and ash, should be eliminated; then the relative proportions of the essential elements, carbon, hydrogen, oxygen and nitrogen, correctly represent the degree of carbonization. Regarded in this manner the Montserrat specimen compares favourably with that from Point Noir, as the following numbers show.

100 parts of true coal, exclusive of water, sulphur and ash, contain :

| | Montserrat. | Point Noir. |
|---|---|---|
| Carbon ... ... ... ... ... | 78·743 | 77·16 |
| Hydrogen ... ... ... ... | 6·258 | 5·95 |
| Oxygen ... ... ... ... ... | 12·128 | 16·89 |
| Nitrogen ... ... ... ... | 2·871 | |

On the other hand, the Montserrat coal, according to the specimen received, contains too large a proportion of sulphur as pyrites.

The presence of much sulphur not only depreciates the value of coal as fuel but becomes highly objectionable when the coal is applied to gas-making, as it results in the gas becoming largely contaminated with sulphur compounds. The latter, being burnt with the gas, generate sulphur dioxide, which not only vitiates the atmosphere but is converted into sulphuric acid, and condensing on books, pictures, etc., rapidly destroys them.

It is more than probable, however, that the thorough ventilation insured in West Indian buildings would render

any effects of this kind much less marked than is the case with the closed-up apartments of Europe.

The maximum quantity of sulphur allowable in coal for gas-making is usually fixed at 2 per cent.; but even the smallest quantity is obnoxious.

It is to be hoped that, as the Montserrat coal is obtained from deeper workings, the amount of this impurity will diminish.

The quantity of ash or mineral matter yielded by the coal is also somewhat high, but this is a fact of minor importance.

In the event of the coal being used for gas-making, it will probably be found that the large quantity of ammonia yielded as a by-product will form a considerable item of remuneration.

The tables appended to this paper give the mean composition of some of the chief British coals for comparison.

## Appendix.

Percentage composition of some typical fuels, exclusive of water, ash and sulphur :—

| | Carbon. | Hydrogen. | Oxygen and Nitrogen. |
|---|---|---|---|
| Lignite ... | 66·96 | 5·28 | 27·76 |
| Earthy Coal ... | 74·20 | 5·89 | 19·91 |
| Brown „ ... | 77·73 | 7·84 | 14·43 |
| Wigan Cannel | 85·81 | 5·85 | 8·34 |
| Hartley ... | 88·42 | 5·61 | 5·97 |
| Anthracite ... | 94·05 | 3·38 | 2·57 |

Average composition of British coal, exclusive of water, ash and sulphur :—

| | Carbon. | Hydrogen. | Oxygen. | Nitrogen. |
|---|---|---|---|---|
| Welsh ... | 89·43 | 5·12 | 4·38 | 1·07 |
| Scotch ... | 82·98 | 5·92 | 10·25 | 0·85 |
| Newcastle | 86·15 | 5·56 | 5·98 | 2·31 |
| Derbyshire | 82·68 | 5·08 | 10·48 | 1·76 |
| Lancashire | 83·14 | 5·65 | 10·14 | 1·07 |

Mean percentage of sulphur found in British coals, in the Admiralty inquiry under Sir H. de la Beche and Dr. Lyon Playfair :—

| Number of Samples. | Kind of Coal. | Per cent. of Sulphur. |
|---|---|---|
| 37 | Welsh | 1·42 |
| 8 | Scotch | 1·45 |
| 17 | Newcastle | 0·94 |
| 8 | Derbyshire | 1 01 |
| 28 | Lancashire | 1·42 |

## II. First Sketch of a Marine Invertebrate Fauna of the Gulf of Paria and its Neighbourhood. By R. J. Lechmere Guppy, F.L.S., C.M.Z.S., etc.

### Part I.—MOLLUSKA.

The following list is only proposed as an instalment of the subject. It will be liable to large expansion, and doubtless to some revision. I have waited for years to be able to furnish a more complete and perfect list; but I perceive that unless a beginning is made no progress can be expected, and I prefer therefore to publish the information I now possess, which can be added to from time to time as opportunity may offer.

All the species enumerated have been collected by myself either in the Gulf of Paria or on the coasts adjoining. Although consisting, for the most part, of names only, yet this list represents a very large amount of work, not only in collecting but in the study and identification of the shells, and in assigning to them their proper names, amid the heap of synonymns and inaccurate determinations with which unfortunately the science of malacology is burdened. My guide as to nomenclature has been chiefly Krebs' catalogue

of the West Indian marine shells,—a work published for private circulation only, but which is most valuable for its suggestions as to synonymy. I have, however, allowed myself considerable liberty in the fusion of specific names allowed to stand in Krebs' list; for the author of that work, while condemning the "sickly passion" which possesses some naturalists for describing so-called new species, still allowed too many doubtful appellations to crowd his pages.

As regards the references to figures, I have generally selected such as portray the species fairly, and where possible I have chosen those most easily accessible to students; only citing the more expensive and larger works on conchology where the ordinary manuals failed me.

In the synonymy the names quoted may not, in all cases, have been originally intended for the species under which they here stand, but may have been incorrectly applied by some author. Owing to the close resemblance of some species of the eastern hemisphere to western ones, it has often happened that one name has been used for two distinct shells; and I am not sure that we have yet in all cases avoided the errors traceable to this source of confusion.

The principle on which the authorities are cited is that the specific names are assigned to the author who first described the species, and not to the one who first adopted a particular collocation of generic and specific names. This principle has been generally acted up to by conchologists; but it is to be regretted that many writers on natural science have followed a different course, thereby introducing unnecessary disorder into nomenclature. The want of a definite enunciation of the rule may be somewhat to blame for this: I propose the following—"The author's

name appended to a specific name is to be regarded as the authority for the specific name *only*."

The classification I have adopted is that I have used in my own cabinet. It is in the main based upon that of Woodward, by far the best ever published. Some of my innovations may seem hazardous, but I have never departed from my model without the most substantial reasons. I have long had in preparation a paper on this subject, but have not yet found the leisure to complete it. I can hardly say anything too strong against the systems devised by various conchological writers, as they seem to be founded on the most arbitrary and artificial characters. I have, in a few instances, renamed the orders, not being able to find any satisfactory terms in use; but wherever I have done so I have derived the ordinal name from the most characteristic genus of the order.

## Sub-kingdom MOLLUSKA.

### Class KEPHALOPODA.

#### *Order* Octopoda.

Octopus Cuvier.

1. O. americanus Orb.
   O. vulgaris, D'Orbigny, Moll. Cuba, vol. i., p. 11, pl. i., f. 1.

#### *Order* Decapoda.

Loligo Lamarck 1799.

2. L. plei Blainv. D'Orb. Moll. Cuba, vol. i., p. 42.

Sepioteuthis Férussac 1825.

3. S. sepioidea Blainv. Orb. Moll. Cuba, vol. i., p. 34.

Spirula Lamarck 1799.

4. Sp. fragilis Lam.

*Sub-class* Solenoconchia.

Dentalium Linné 1740.

5. D. disparile Orb. Moll. Cuba, vol. ii., p. 202, pl. xxv., f. 14-17.

Class GASTROPODA.

*Order* Tectibranchiata.

Notarchus Cuvier 1817.

6. N. laciniatus Rüppell. Gray, Fig. Moll., pl. clii, f. 1.

Aclesia Rang 1828.

7. Acl. sp. indet.

Aplysia Linné 1767.

8. Apl. nigra Orb., Voy. Amer., Mer., p. 209, pl. xviii., f. 1, 2.
9. Apl. sp. indet.

Bulla Klein 1753.

10. B. striata Brug. Chenu, Man. Conch., vol. i., f. 2939-41.
    B. maculosa Mart.
    B. media Phil.
    B. umbilicata Bolt.

*Order* Holostomata.

(*Sub-order Pyramidellina.*)

Turbonilla Risso 1826.

11. T. turris Orb. Chenu., Man. Conch., vol. i., f. 1287.

Chemnitzia turris Orb. Moll. Cuba, vol i., p. 219, pl. xvi., f. 10-13.

,, pulchella Orb. l. c., p. 220, pl. xvi., f. 14-17.

,, ornata Orb. l. c., p. 221, pl. xvi., f. 18-21.

,, modesta Orb. l. c., p. 222, pl. xvi., f. 22-24.

(*Sub-order Naticina.*)

NATICA Adanson 1757.

12. **N. marocana** Chemn. Wood, Ind. Test. Nerita, 14.
N. marochiensis (?) Lam.

13. **N. canrena** Linn. Wood, Ind. Test. Nerita, 1.
N. alapapilionis Chemn. Chenu, Conch., vol. i., f. 1163.

*Order* CALYPTREACEA.

CREPIDULA Lamarck 1799.

14. **Cr. aculeata** Chemn. Chenu, Man. Conch., vol. i., f. 2355-56.
D'Orbigny, Voy. Amer. Merid., p. 464, pl. lviii., f. 4, 5.

15. **Cr. porcellana** Lam. Cuvier, Regne An., pl. xlvii., f. 5.
Cr. protea, Orb. Moll. Cuba, vol. ii., p. 192, pl. xxiv., f. 30-33.

CALYPTREA Lamark 1799.

16. **C. auriculata** Chemn. Reeve, C. I., Crucibulum, 15.
C. cuvieri Desh. in Cuv. Regne An., pl. xlviii., f. 4.

TROCHITA Schumacher, 1817.

17. **Tr. candeana** Orb. Moll. Cuba, vol. ii., p. 190, pl. xxiv., f. 28, 29.

*Order* Docoglossa.

Patella Linné 1752.

18. **P. elegans** Phil.
    P. candeana Orb. Moll. Cuba, vol. ii., pl. xxv., f. 1-3.
    Tectura fascicularis Menke.

*Order* Chitonacea.

Chiton Linné.

19. **Ch. rugosus** Gray, Reeve, C. I. Chiton, 115.
    Ch. squalidus Adams.
    Ch. guildingi Reeve.
20. **Ch. segmentatus** Reeve.
    Chaetopleura janeirensis Gray.
    Ch. apparata = rufocostata.
21. **Ch. caribeorum** Carpenter.
22. **Ch. marmoratus** Gmelin.

*Order* Cerithiacea.

Turritella Lamarck 1799.

23. **T. imbricata** Linn. Woodward, Man. Moll., pl. ix., f. 1. Hanley, Ips. Linn. Conch., p. 344, pl. iii., f. 2 (pale var.).

Cerithiopsis Forbes.

24. **C. punctatum** Linn. (not Brug. nor Lam.)
    C. emersoni Adams.
    C. subulatum Montf.

Cerithium Bruguières 1789.

25. **C. gibberulum** Adams.
    ? C. columellare Orb. Moll. Cuba, vol. ii., p. 155, pl. xxiii., f. 13-15.
26. **C. caudatum** Sow.

LITORINA Férussac 1821.

27. **L. nodulosa** Gmel. Orb. Moll. Cuba, vol. i., p. 205, pl. xiv., f. 11-14.
L. dilatata Orb. l. c., p. 207, pl. xiv., f. 20-23.
L. tuberculata Orb. l. c., p. 206, pl. xiv., f. 15-19.

28. **L. flava** King. D'Orb. Voy. Amer. Mer., p. 391, pl. liii., f. 1-3.
L. irrorata var. Petit.

29. **L. ziczac** Chemn. Chenu, Man. Conch., vol. i., f. 2107.
L. lineata Orb. Moll. Cuba, vol. i., p. 208, pl. xiv., f. 24-27.

30. **L. columellaris** Orb. Moll. Cuba, vol. i., p. 213, pl. xv., f. 18-20.

31. **L. tigrina** Orb. l. c., vol. i., p. 211, pl. xv., f. 9-11.

32. **L. angulifera** Lam. Chenu, Man. Conch., vol. i., f. 2093.
L. scabra Orb. (as of Linn.) Moll. Cuba, vol. i., p. 212, pl. xv., f. 15-17.

MODULUS Gray 1840.

33. **M. lenticularis** Chemn. Chenu, Man. Conch., vol. i., f. 2122.

34. **M. unidens** Chemn. Wood, Ind. Test. Trochus, 71.
Trochus perlatus Wood.
Monodonta carchedonius Lam.

SOLARIUM Lamarck 1799.

35. **S. tesselatum** Desh. Wood, Ind. Test., pl. xxix., f. 56.

*Order* VOLUTACEA.

VOLUTA Linné.

36. **V. musica** Linn. Woodward, Man. Moll., pl. vii., f. 9.

MARGINELLA Lamarck 1799.

37. **M. coerulescens** Lam. Wood, Ind. Test., Voluta, 68.
M. subcoerulea Mart.
Voluta prunum Gmel.
38. **M. marginata** Born.
M. bivaricosa Lam. Chenu, Man. Conch., vol. i., f. 1057-8.
39. **M. interrupta** Lam.

CYPRAEA Linné.

40. **C. exanthema** Linn. Chenu., Man. Conch., vol. i., f. 1675.

*Order* CONACEA.

CONUS Linné.

41. **C. testudinarius** Mart.

PLEUROTOMA Lamarck 1799.

42. **Pl. antillarum** Orb. Moll. Cuba, vol. ii.; p. 173, pl. xxiv., f. 1-3.

*Order* FUSACEA.

(*Sub-order Muricina.*)

MUREX Linné.

43. **M. pomiformis** Mart.
M. asperrimus Orb.
44. **M. cornucervi** Mart.
M. brevifrons Lam.
M. calcitrapa Lam.
M. purpuratus Reeve.
M. elongatus Lam.
45. **M. similis** Sow.

46. M. nuceus Mörch.
47. M. messorius Sow.
48. M. alveatus Kiener.

LAMPUSIA Schumacher 1817. (Triton auctt.)

49. L. antillarum Orb. Moll. Cuba, vol. ii., p. 161, pl. xxiii., f. 20.
    L. tuberosum Reeve.
50. L. succincta Lam.
    Triton americanum Orb. Moll. Cuba, vol. ii., p. 163, pl. xxiii., f. 22.
51. L. martiniana Orb.
    Murex pileare (Linn) auctt.

RANELLA Lamarck.

52. R. cubaniana Orb. Moll. Cuba, vol. ii., p. 165, pl. xxiii., f. 24.

PERSONA Montfort 1810.

53. P. reticularis Linn.

(*Sub-order Fusina.*)

TURBINELLUS Lamarck 1799.

54. T. nassa Gmel. Chenu, Man. Conch., vol. i., f. 913.
    T. cingulifera Lam. Kiener, Coq. Viv. Turbinellus, 23.
    T. rudis Reeve.
    T. brasilianus Orb. Voy. Amer. Mer., p. 449, pl. lxxvii., f. 17.
    T. knorri Desh. Wood, Ind. Test. Murex, 110.
55. T. infundibulum Gmelin. Wood, Ind. Test. Murex, 118.
    T. gibbulus Gmel.
    T. filosus Lam. Chenu, Man. Conch., vol. i., f. 907.

Fasciolaria Lamarck 1799.

56. F. tulipa Linn. Woodward, Man. Moll., pl. v., f. 1.

Pyrula Lamarck 1799.

57. P. melongena Linn. Woodward, Man. Moll., pl. v., f. 7.

58. P. morio Linn. Kiener, Coq. Viv. Fusus, 46.
Fusus coronatus Lam.

Pusio Gray 1833.

59. P. articulatus Lamarck. Chenu, Man. Conch., vol. i., f. 617.
Murex accinctus Born.
Buccinum pennatum Martini.
,, plumatum Gmel.
Purpura accincta Orb.
Fusus articulatus Kien. Coq. Viv. Fusus, 36.

(*Sub-order Strombina.*)

Strombus Linné 1740.

60. Str. gigas Linn. Chenu, Man. Conch., vol. i., f. 1583.
Str. goliath Chemn., Chenu, Man. Conch., vol. i., f. 1581.

61. Str. gallus Linn. Chenu, Man. Conch., vol. i., f. 1588.

62. Str. pugilis Linn. Woodward, Man. Moll., pl. iv., f. 1.

(*Sub-order Buccinina.*)

Cassis Lamarck 1799.

63. C. testiculus Linn. Chenu, Man. Conch., vol. i., f. 1134.

Dolium Lamarck 1801.

64. D. pennatum Mart. (= D. perdix auctt.)

PURPURA Bruguières 1789.

65. P. patulum Linn. Wood, Ind. Test., pl. xxii., f. 53.

66. P. trapa Bolt.

P. deltoidea Lam.

67. P. bicostalis Lam.

P. haemastoma Orb. Moll. Cuba, vol. ii., p. 144.

68. P. undata Lam.

P. bicarinata Kien.

P. nodus Wood, Ind. Test. Murex, 48.

69. P. trinitatensis Guppy, Proc. S. A. Trin., vol. i., p. 366. Ann. and Mag. Nat. Hist., Jan. 1875, p. 50.

70. P. gigantea Reeve.

Buccinum haemastoma Chemn.

Purpura consul Kien. (not Lam.)

71. P. plicata Mart.

P. galea Orb. (not Chemn.)

72. P. auriculata Lam.

Buccinum coromandelianum Lam.

Pollia tincta Conrad.

RICINULA Lamarck 1812.

73. R. turbinella Kien. Woodward, Man. Moll., pl. iv., f. 15.

R. nodulosa Adams.

R. carbonaria Adams.

R. ferruginosa Reeve.

74. R. lugubris Adams.

PLANAXIS Lamarck 1822.

75. Pl. nucleus Lam. Chenu., Man. Conch., vol. i., f. 2143.

NASSA Lamarck 1822.

76. N. antillarum Orb. Moll. Cuba, vol. ii., p. 141, pl. xxxiii., f. 1-3.

COLUMBELLA Lamarck 1799.

77. **C. mercatoria** Linn. Woodward, Man. Moll., pl. vi., f. 10.

78. **C. laevigata** Lam.

C. concinna Sow. Wood, Ind. Test., pl. xxi., f. 134.

Voluta ocellata Gmel.

79. **C. argus** Orb. Moll. Cuba, vol. ii., p. 138, pl. xxxi., f. 34-37.

C. oscillatoria Sow.

C. cribraria Lam.

OLIVA Bruguières 1789.

80. **O. reticularis** Lam.

O. olivaceus Mörch.

81. **O. oryza** Lam.

82. **O. nitidula** Dillw.

O. mutica Reeve.

O. monilifera Reeve.

*Order* TROCHACEA.

(*Sub-order Trochina.*)

ASTRALIUM Link 1807.

83. **Astr. rhodostomum** Lam.

TROCHUS Linné 1758.

84. **Tr. byronianus** Gray.

Tr. hotessierianus Orb. Moll. Cuba, vol. ii., p. 59, pl. xviii., f. 15-17.

Tr. canaliculatus Orb. l. c., vol. ii.. p. 60, pl. xviii., f. 18-19.

85. **Tr. excavatus** Lam.

Tr. umbilicaris Chemn.

TURBO Linné.

86. **T. tuber** Linn.

(*Sub-order Neritinina.*)

NERITA Linné.

87. **N. peleronta** Linn. Wood, Ind. Test., pl. xxxvi., f. 46.
88. **N. antillarum** Gmel. Wood, Ind. Test. Nerita, 45.
N. praecognita Adams.

NERITINA Lamarck 1809.

89. **N. meleagris** Lam.
90. **N. viridis** Linn. Chenu, Man. Conch., vol. i., f. 2460.
91. **N. microstoma** Orb. Moll. Cuba, vol. ii., p. 47, pl. xvii., f. 35.

*Order* FISSURELLACEA.

FISSURELLA Lamarck 1801.

92. **F. radiata** Lam.

CLASS CONCHIFERA.

*Order* PHOLADACEA.

PHOLAS Linné.

93. **Ph. candeana** Orb. Moll. Cuba, pl. xxv., f. 18-19.
94. **Ph. costata** Linn. Chenu, vol. ii., f. 1-3.

MARTESIA Leach 1847.

95. **M. striata** Linn. Chenu., vol. ii., f. 48-50.
Woodward Man., pl. xxiii., f. 21.

TEREDO Linné.

96. **T. norvegica** Spengl. Woodward, Man., pl. xxiii., f. 26.

GASTROCHAENA Lamarck 1818.

97. **G. hians** Chemn. Wood, Ind. Test. Pholas, 11.
G. cuneiformis Spengl. Chenu, vol. ii., f. 73.

*Order* ANATINACEA.

THRACIA Leach 1824.

98. **Thr. dissimilis** Guppy, Proc. S. A. Trinidad, vol. i., p. 368. Ann. and Mag. Nat. Hist., Jan. 1875, p. 52.
Thr. plicata Reeve (not Deshayes), C. I. Thracia, 7.

PERIPLOMA Schumacher 1817.

99. **P. inequivalvis** Schum.

*Order* SOLENACEA.

SOLEN Linné.

100. **S. obliquus** Spengl. Wood, Appendix, pl. xi., f. 17.
S. ambiguus Lam. Chenu, Man., vol. ii., f. 86.
101. **S. niveus** Hanley. Wood, Appendix, pl. xii., f. 40.

SOLECURTUS Blainville 1824.

102. **S. caribeus** Lam.
S. gibbus Spengler.
S. guinensis Dillwyn.

*Order* MYACEA.

CORBULA Bruguières 1792.

103. **C. cubaniana** Orb. Chenu, Man., vol. i., f. 137.
C. knoxiana Adams. Contr. Conch., p. 238.
104. **C. caribea** Orb. Moll. Cuba, pl. xxvii., f. 5-8.
C. swiftiana Adams. Contr. Conch., p. 236.
C. kjoeriana Adams, l. c., p. 237.

*Order* MACTRACEA.

MACTRA Linné.

105. **M. tumida** Chemn. Wood, Ind. Test. Mactra, 8.
M. turgida Gmel. Chenu, Man., vol. ii., f. 223-4.
M. guadelupensis Recluz.

106. **M. pellucida** Chemn.
M. ovalina Lam.
M. fragilis Wood, Ind. Test. Mactra, 32.
M. brasiliana Lam. Wood, Appendix, pl. x., f. 60.

107. **M. alata** Spengl. Wood, Ind. Test. Suppl. Mactra, 7.
M. carinata Lam. Chenu, Man., vol. ii., f. 227-8.

*Order* LUCINACEA.

(*Sub-order Donacina.*)

IPHIGENIA Schumacher 1817.

108. **I. braziliensis** Lam. Woodward, pl. xxi., f. 20.

DONAX Linné.

109. **D. denticulatus** Linn. Woodward, pl. xxi., f. 19.

110. **D. striatus** Linn. Wood, Appendix, pl. xiv., f. 32.

111. **D. pulchellus** Hanley. Wood, Appendix, p. xiv., f. 19.
D. powisianus Recluz.

ASAPHIS Modeer 1793.

112. **A. deflorata** Linn.
A. rugosa Lam. Chenu, Man., vol. ii., f. 256.

(*Sub-order Lucinina.*)

SEMELE Schumacher 1817.

113. **S. reticulata** Linn. Woodward, pl. xxi., f. 11.

114. **S. decussata** Gray. Wood, Ind. Test. Tellina, 81.
Amphidesma jayanum Adams.

115. S. variegata Lam. Wood, Ind. Test. Tellina, 17.
S. purpurascens Gmel.

ERVILIA Turton 1822.

116. E. nitens Turt. Woodward, pl. xxi., f. 18.

TELLINA Linné.

117. T. interrupta Wood, Ind. Test. Tellina. 4.
T. listeri Bolten.
T. maculosa Lam.
118. T. punicea Born. Wood, Ind. Test. Tellina, 47.
T. angulosa Gmel. Wood, l. c., Tellina, 64.
T. striata Chemn.
T. alternata Say.
Donax martinicensis Lam.
119. T. rufescens Chemn. Wood, Ind. Test. Tellina, 37.
T. operculata Gmel.
120. T. gruneri Phil.
T. interstriata Say.
T. inornata Adams.
121. T. fausta Dillwyn. Wood, Ind. Test. Tellina, 74.
T. remies Born (not Linn.).
T. laevis Wood, Ind. Test. Tellina, 68.
122. T. radiata Linn. Chenu, Man., vol. ii., f. 272.
123. T. sexradiata Lam. Wood, Appendix, pl. xi., . 37.
124. T. exilis Lam.
125. T. candeana Orb. Moll. Cuba, pl. xxv., f. 50-52.

TELLIDORA Mörch (?)

126. T. schrammi Recluz.

STRIGILLA Turton 1822.

127. **Str. carnaria** Linn. Woodward, pl. xxi., f. 6.

128. **Str. flexuosa** Say.

Tellina mirabilis Phil.

LUCINA Bruguières 1792.

129. **L. pensylvanica** Linn. Woodward, pl. xix., f. 6.

130. **L. jamaicensis** Spengler. Chenu, vol. ii., f. 566.

131. **L. pecten** Lam.

L. costata Orb. Moll. Cuba, pl. xxvii., f. 40-42.

L. textilis Phil.

L. antillarum Reeve.

132. **L. scabra** Lam. Chenu, vol. ii., f. 576.

Tellina imbricata Chemn.

L. scobinata Recluz.

L. muricata Orb. (not Chemn.).

133. **L. muricata** Chemnitz.

L. scabra Reeve (not Lam.)

134. **L. nasuta** Conr.

L. imbricatula Adams. Contr. Conch., p. 245.

L. obliqua Reeve (not Phil.)

L. pectinata Adams. Contr. Conch., p. 245.

L. pecten Reeve.

L. occidentalis Reeve.

135. **L. semireticulata** Orb. Voy. Amer. Mer., pl. lxxxiv., f. 7-9.

L. granulosa Adams. Proc. Bost. Soc., 1845.

136. **L. quadrisulcata** Orb. Moll. Cuba, pl. xxvii., f. 34-36.

L. serrata Orb. Moll. Cuba, pl. xxvii., f. 37-39.

L. divaricata Lam. (not Linn.) Chenu, vol. ii., f. 572.

L. americana Adams. Contr. Conch., p. 243.
L. chemnitzii Phil.
L. pilula Adams. Contr. Conch., p. 246.

Diplodonta Brown 1831.

137. **D. brasiliensis** Phil. Chenu, Man., vol. ii., f. 590.
138. **D. candeana** Orb. Moll. Cuba, pl. xxvii., f. 43-45.

Lucinopsis Forbes 1848.

139. **L. tenuis** Recluz.

Dosinia Scopoli 1777.

140. **D. philippii** Orb. Moll. Cuba, vol. ii., p. 270.
Cytherea concentrica Lam. (not Born).
,, patagonica Phil.

*Order* Astartacea.

Crassinella Guppy 1875.

141. **Cr. martinicensis** Orb. Moll. Cuba, pl. xxvii., f. 21-23.
Crassatella guadelupensis Orb., l. c., pl. xxvii., f .24-26.

*Order* Veneracea.

Petricola Lamarck 1801.

142. **P. typica** Jonas. Mollusk. Beitr., pl. vii., f. 3.
143. **P. gracilis** Desh. Proc. Zool. Soc., 1853.

Cytherea Lamarck 1809.

144. **C. hebraea** Lam. Wood, Appendix, pl. xiii.. f. 21.
C. rubiginosa Phil.
C. varians Hanley. Wood, Appendix, pl. xv., f. 33.
145. **C. albida** Gmel. Wood, Appendix, pl. xv., f. 31.
C. affinis Gmel.
C. laeta Lam. (not Linn.)

146. **C. convexa** Say. Wood, Appendix, pl. x., f. 34.
147. **C. dione** Linn. Chenu, Man., vol. ii., f. 378-379.
[N.B.—Woodward's figure (Man., pl. xx., f. 8) represents *C. lupinaria* Lesson.]

TRIGONA Megerle 1811.

148. **Tr. trigonella** Lam. Wood, Appendix, pl. xiii., f. 18.
149. **Tr. mactroides** Born. Wood, Ind. Test. Venus, 33.
Cytherea corbicula Lam. Chenu, vol. ii., f. 385-387.

VENUS Linné.

150. **V. flexuosa** Linn. Chenu, vol. ii., f. 360.
V. macrodon Lam. Wood, Appendix, pl. ix., f. 7.
V. punctifera Gray.
151. **V. paphia** Linn. Woodward, pl. xx., f. 6.
152. **V. cancellata** Linn. Wood, Ind. Test. Venus, 6.
V. cingenda Dillwyn.
V. dysera Orb.
153. **V. granulata** Gmel. Wood, Ind. Test. Venus, 29.
V. violacea Gmelin.
V. marica Chemnitz.
154. **V. pectorina** Lam.
V. elegans Gray. Wood, Ind. Test. Suppl., pl. ii., f. 3.
155. **V. eximia** Phil.
? V. portesiana Orb. Voy. Amer. Mer., pl. lxxxiii., f. 1, 2.
156. **V. rugosa** Chemn. Wood, Ind. Test. Venus, 13.
V. rigida Dillwyn.

*Order* CARDIACEA.

CARDIUM Linné.

157. **C. muricatum** Linn. Wood, Ind. Test. Cardium, 14.

158. **C. eburniferum** Guppy. Proc. S. A. Trinidad, vol. i., p. 367. Ann. and Mag. Nat. Hist., Jan. 1875, pl. vii., f. 3.

[N.B.—Like *C. isocardium*, but having the vaulted scales much stouter and more crowded.]

159. **C. leucostomum** Born.

C. elongatum Lam. Wood, Appendix, pl. xvii., f. 16.

C. subelongatum Sow.

C. marmoreum Lam.

160. **C. oviputamen** Reeve.

161. **C. citrinum** Chemn. Wood, Ind. Test. Cardium, 22.

C. serratum Linn.

C. laevigatum Lam.

162. **C. haitense** Sow. Geol. Journ., vol. vi., pl. x., f. 11. Ann. and Mag. Nat. Hist., Jan. 1875, p. 51.

CARDITA Bruguières 1789.

163. **C. pectunculus** Brug. Chenu, vol. ii., f. 655-656.

CHAMA Bruguières 1789.

164. **Ch. macrophylla** Chemn. Wood, Ind. Test. Chama, 19.

Ch. imbricata Lam.

Ch. lazarus Lam. (not Linn.)

Ch. gryphoides Dillw. (not Linn.)

165. **Ch. florida** Lam.

166. **Ch. ruderalis** Lam.

*Order* MYTILACEA.

(*Sub-order Mytilina.*)

PINNA Linné.

167. **P. ramulosa** Reeve. C. I. Pinna, 52.

P. seminuda auctt. (as of Lam.)

P. rigida (Solander) Orb. Wood, Ind. Test. Pinna, 7.

P. nobilis Chemn. (not Linn.)

P. orbignyi Hanley, Reeve, C. I. Pinna, 49.

MYTILUS Linné.

168. **M. americanus** Favart.

M. modiolus Chemn. (not Linn.)

M. tulipa Lam. (part.)

169. **M. brasiliensis** Chemn.

M. guianensis Lam.

M. semifusca Sow.

170. **M. ligneus** Reeve.

[This species spins a bag entirely covering the shell. It is extremely rare, and lives in 2 to 3 fms. water, on a bottom of sandy mud. No locality is given by Reeve for his shell.]

171. **M. exustus** Linn. Orb. Moll. Cuba, pl. xxviii., f. 6, 7.

M. citrinus Chemn. Wood, Ind. Test. Arca, 15.

M. sulcata Lam.

172. **M. domingensis** Lam. Orb. Moll. Cuba, vol. ii., pl. xxviii., f. 8, 9.

M. exustus Lam.

CRENELLA Brown 1827.

173. **Cr. viator** Orb. Voy. Amer. Mer., pl. lxxxiv., f. 34-37.

LITHODOMUS Cuvier 1817.

174. **L. bipenniferus** n. sp.

Elongate, sub-cylindrical, nearly straight, smooth, thin, epidermis yellowish-brown, generally incrusted with a blackish deposit, running posteriorly into white

pointed calcareous rostriform appendages which cross each other, in different specimens with the beak of either above or below. Umbones round, terminal. Ventral edge scarcely curved. Dorsal edge slightly angulate. Length 35-45, height 10, thickness 11 mill.

This shell differs from *L. caudigerus*, its West African analogue, in being more cylindrical; the umbones are usually less prominent and more nearly terminal; the dorsal edge has rarely so pronounced an angle. Burrows in soft limestone and corals.

(*Sub-order Pectinina.*)

Perna Bruguières 1792.

175. **P. obliqua** Lam.

P. ephippium Sow. (not Linn.) Woodward, pl. xvii., f. 2.

Ostrea alata Gmelin.

176. **P. chemnitziana** Orb.

P. vulcella (b) Lamarck.

Concha semiaurita Chemnitz.

Perna bicolor Adams.

Pecten (Gualtieri) Bruguières 1797.

177. **P. nucleus** Born. Wood, Ind. Test. Ostrea, 47.

P. turgidus Lam.

178. **P. nodosus** Linn. Chenu, vol. ii., f. 922.

179. **P. circularis** (?) Sow. Thes. Conch., pl. xii., f. 23.

Lima Bruguières 1792.

180. **L. scabra** Born. Chenu, Man., vol. ii., f. 954, 955.

L. aspera Chemn.

L. bullata Born.

L. fragilis Lam.
L. inflata Lam.
L. glacialis Lam.
L. pellucida Adams.

PLICATULA Lamarck 1801.

181. **Pl. cristata** Lam. Woodward, pl. xvi., f. 17.
Ostrea spondyloidea Meuschen.
Spondylus plicatus Chemn.
Pl. reniformis Lamarck.

(*Sub-order Ostreina.*)

OSTREA Linné.

182. **O. frons** Linn. Wood, Ind. Test. Mytilus, 3.
O. parasitica Gmel. (part). Wood, Ind. Test., pl. xi., f. 71.
O. radicum Chemn.
O. arborea Chemn.
O. rubella Lam.
O. limacella Lam. Chenu, Man., vol. ii., f. 1005.
O. erucella Lam.
O. folium Reeve (not Linn.).
O. rhizophorae Guilding.

*Order* ARCACEA.

LEDA Schumacher 1817.

183. **L. jamaicensis** Orb. (var.) Chenu, vol. ii., f. 901-903.

ARCA Linné.

184. **A. umbonata** Lam. Wood, Ind. Test. Arca, 14.
A. ventricosa Lam.
A. mutabilis Reeve.

A. americana Orb. (not Gray). Moll. Cuba, pl. xxviii., f. 1, 2.

A. noae auctt. (not Linn.)

185. **A. occidentalis** Phil.

A. navicularis Brug. Wood, Ind. Test. Arca, 5.

186. **A. listeri** Phil.

A. fusca Brug.

A. granulata Meusch.

187. **A. incongrua** Say. Wood, Appendix, pl. xviii., f. 44.

A. braziliana (?) Lam. Wood, Ind. Test. Suppl. Arca, 7.

A. inequivalvis (?) Brug.

188. **A. adamsi** Shuttl.

189. **A. americana** Gray. Wood, Ind. Test. Suppl. Arca, 1.

A. pexata (?) Say.

190. **A. centrota** Guppy. Proc. S. A. Trinidad, vol. i., p. 368. Ann. and Mag. N. Hist., Jan. 1875, pl. vii., f. 4.

191. **A. floridana** Conrad (var.)

192. **A. auriculata** Lam. Chenu, vol. ii., f. 865, 866.

193. **A. squamosa** Lam. (not Gray).

A. donaciformis Reeve. Chenu, vol. ii., f. 863.

A. divaricata Sow.

A. domingensis Lam.

A. angulata Meuschen.

PECTUNCULUS Lamarck 1801.

194. **P. decussatus** Linn.

P. pennaceus Lam.

P. undatus Lam.

P. angulatus Lam.

P. hirtus Phil.

## NOTICES OF MEMOIRS.

On the Older Tertiary Formations of the West Indian Islands. By P. Martin Duncan, M.B., F.R.S., F.G.S., etc. [*Quart. Journ. Geol. Society*, vol. xxix. (1873), *pp.* 548-565.]

In this communication Professor Duncan records the discovery of *Echinolampas ovum-serpentis*, *Ranina porifera*, *Terebratula carneoides*, and *Argiope clevei* by Mr. P. T. Cleve, in certain strata in the island of S. Barts. From the associated fossils there seems little doubt that these strata are of pre-miocene age; and thus the surmise made some years ago as to the eocene age of the Sanfernando beds in Trinidad, is placed on a basis of greater certainty. Professor Duncan describes a number of corals from the eocene limestone of S. Barts, and his memoir is illustrated by four plates.

On Prorastomus Sirenoides. By Prof. Owen, C.B., F.R.S., F.G.S., etc. [*Quart. Journ. Geol. Soc.*, vol. xxxi. (1875), *p.* 559.]

A fossil sirenian mammal was in the year 1855 described by Prof. Owen under the above name, having been discovered in a hard grey limestone in Jamaica. The fossil in question has been submitted by Prof. Owen to a fresh scrutiny, and he has found that by further chiselling away the matrix, many additional characters were exposed. These are described and explained in this memoir, which is illustrated by two plates.

DESCRIPTION OF SOME NEW GENERA OF MOLLUSKA. By William M. Gabb. [*Proc. Acad. Nat. Sciences*, Philadelphia, 1872, p. 270.]

Twelve new genera of fossil molluska from the miocene deposits of Haiti are described in this communication, and figures of the typical forms are given. It will remain for future inquiry to determine if any and which of the names proposed ought to stand.

ON THE TOPOGRAPHY AND GEOLOGY OF SANTO DOMINGO. By William M. Gabb. [*Transactions American Philosophical Society*, vol. xv., pp. 49—259.]

This communication contains the results of a three years' geological survey of the greater part of the territory occupied by the Republic of Santo Domingo, in the island of Haiti, conducted by Professor Gabb and his assistants, under the auspices of the government of the Republic. A geological map of the country accompanies the paper, which may be regarded as a valuable contribution to our knowledge of the physical structure of the West Indies. The formations found by Prof. Gabb to occur in Haiti are classed as post-pliocene, miocene, cretaceous, and eruptive. A very large number of fossils are recorded and described by Prof. Gabb, whose remarks on previously described species will be of great use to paleontologists. Many new species are described, some of which are unquestionably open to revision.

ON THE WEST INDIAN TERTIARY FOSSILS. By R. J. Lechmere Guppy, F.L.S., F.G.S., etc. [*Geological Magazine*, 1874, Sept. and Oct., and 1875, January.]

This paper is for the most part a *resumé* of what has been

published since 1867 on the tertiary molluska of the West Indies, accompanied by descriptions of new species, which are figured on three plates. A revised list of all the recorded species is appended.

NOTE ON TWO TERTIARY SPECIES OF BRACHIOPODA FROM THE ISLAND OF S. BARTHOLOMEW, *one of the North-Eastern West Indian Islands.* By Thomas Davidson, F.R.S., F.G.S., etc. [*Geological Magazine*, 1874, p. 158.]

Descriptions accompanied with excellent figures of *Terebratula carneoides* and *Argiope clevei.*

ON THE OCCURRENCE OF HELIX COACTILIATA IN TRINIDAD ; *with Remarks on the Distribution of the Land and Freshwater Molluska of that Island.* By R. J. Lechmere Guppy, F.L.S., F.G.S., etc. [*Proc. Zool. Soc.*, 1875, pp. 318-322.]

A LIST OF THE LAND AND FRESHWATER SHELLS OF TRINIDAD. By R. J. Lechmere Guppy, F.L.S., F.G.S., C.M.Z.S., etc. [*Quart. Journal of Conchology*, November, 1875, p. 109.]

The contents of the two papers above named are sufficiently indicated by their titles.

DISCOVERY OF A BOILING LAKE IN DOMINICA. By H. Prestoe. [*Proc. R. Geog. Soc.*, vol. xx., p. 230, 7th April, 1876.]

ON THE MIOCENE FOSSILS OF HAITI. By R. J. Lechmere Guppy, F.L.S., etc. [*Quart. Journ. Geol. Soc.*, vol. xxxii., 1876, p. 516.]

This memoir, which is accompanied by two plates of new

species of fossil shells, is an addition to our knowledge of the miocene fauna of the West Indies.

Synopsis Molluscorum Marinorum Indiarum Occidentalium. Autore O. A. L. Mörch.

This is the first part of a list of the marine molluska of the West Indies, and will be of great use to naturalists, notwithstanding the extent to which the subdivision of species and genera is carried by the author.

Synopsis Familiæ Scalidarum Indiarum Occidentalium. Autore O. A. L. Mörch.

A review of the West Indian species of the genus *Scalaria*. The author enumerates no less than 40 species, the greater part of which will probably prove to be merely nominal, and founded on individual characters.

Sur l'Existence du genre Haliotinella aux Antilles. Par R. J. Lechmere Guppy. [*Journ. Conch.*, 1876, p. 161.]

Notice of a shell of the genus *Haliotinella* found in the Antilles.

On a Collection of Birds from the Island of Trinidad. By O. Finsch. [*Proc. Zool. Soc.*, 1870, p. 552.]

A Revision of the Neotropical Anatidae. By P. L. Sclater, M.A., Ph.D., etc., and Osbert Salvin, M.A., etc. [*Proc. Zool. Soc.*, 1876, p. 358.]

Description des Echinides Tertiaires des Iles S. Barthelemy et Anguilla. Par M. Cotteau. [*Kongl.*

*Svenska Vetenskaps-Akademiens Handlingar*, *Band* 13, No. 6, 1875.]

The author enumerates and describes the echinoderms of the eocene and miocene beds of the West Indies. He mentions 33 species, which are illustrated in eight quarto plates.

Notice of some Deep-sea and Litoral Corals, etc. By Prof. P. Martin Duncan, F.R.S., etc. [*Proc. Zool. Soc.* 1876, p. 428.]

Some species from the West Indies are described and figured.

A new Butterfly (*Sphaenogona semiflava*, Butler) found in Trinidad by Mr. H. W. Caird, is described in the June 1875 number of the Annals and Magazine of Natural History, p. 396.

List of Vertebrata from Trinidad in the Gardens of the Zoological Society of London :—

*Carnivora*.—Cercoleptes caudivolous, Pallas, Kinkajou.

*Rodentia*.—Sphingurus prehensilis, Linn. (Brazilian Tree Porcupine). Coelogenys paca, Linn (Spotted Cavy). Dasyprocta aguti, Linn (Golden Aguti).

*Aves*.—Quiscalus lugubris, Swains (Black Troupial). Steatornis caripensis, Humb. (Oil Bird or Cave Bird). Ara ararauna, Linn. (Blue and Yellow Macaw). Conurus pavua, Bodd (Green Conure). Chrysotis ochroptera Gmel. (Yellow-shouldered Amazon). Columba leucocephala, Linn. (White Ground Pigeon). Crax globicera, Linn. (Globose Curassow). Crax alector, Linn. (Crested Curassow). Eurypyga helias, Pallas (Sun Bittern).

*Reptilia*.—Clemmys punctularia, Daud. Cinosternon scorpoides, Linn. Podocnemis dumeriliana. Platemys gordoni, Gray, described by Dr. J. E. Gray as Hydraspis Gordoni. (See *Proc. Scient. Assoc.*, 1869, vol. i., p. 375.)

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# PROCEEDINGS

OF THE

# SCIENTIFIC ASSOCIATION

OF

# TRINIDAD.

PART XII.—DECEMBER 1881.

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PROCEEDINGS

OF THE

SCIENTIFIC ASSOCIATION

OF

TRINIDAD.

PART XII.] DECEMBER, 1881. [VOL. II., No. 4.

16*th January*, 1878.

R. J. LECHMERE GUPPY, Esq., F.L.S., F.G.S., President, in the chair.

Wilhelm Devenish, Esq., M.R.C.S., and Washington Arrowsmith, Esq., were elected Members.

The Association then proceeded to the election of Officers for the current year. The following were elected:—

Samuel Leonard Crane, M.D., M.R.C.S., *President.*

Robert John Lechmere Guppy, F.L.S., F.G.S., etc.
Henry William Caird, M.A. } *Vice-Presidents.*

Ernest Francis, F.C.S., *Secretary and Treasurer.*

The following communication was read:—

ON THE LAND SHELLS OF S. VINCENT, W.I. By R. J. Lechmere Guppy, F.L.S., F.G.S., C.M.Z.S., etc.

A visit of two or three weeks to S. Vincent (Westindies)

enables me to contribute something to a settlement of some doubtful points respecting one or two of the terrestrial molluska of that island. Unfortunately my state of health prevented me from doing as much as I had wished; and the excessive heat of the weather (from 92° to 94° in the shade every day) rendered active exertion difficult.

I append a list of the land-shells of S. Vincent, in which are distinguished those named in Bland's list (Ann. Lyc. Nat. Hist., New York, vol. vii., 1861) and those which I have found, but which are not recorded in his list. I proceed to remark on such of the species as appear to deserve particular notice.

Land-shells are much scarcer in S. Vincent than in Grenada and Dominica and other islands of the Antilles. Nevertheless the mountains seemed exceedingly favorable for the development of mollusks, yet they were rare; and I attribute this fact to the action of birds. I met with many dead shells, the contents of which had evidently been extracted by birds.

Of *Guppya livida* I only found a few specimens; these were in different stages of growth, and enabled me to ascertain the fact that my *Conulus vacans* found in Trinidad is the same species, and that therefore the name given by me must be abandoned in favor of Guilding's.

This, it appears to me, is a suitable occasion to make an observation on the use of the name *Stenopus*, applied by Guilding (1828) to two species of land-shells found by him in S. Vincent. The name *Stenopus* was originally given by Latreille (1829) to a crustacean, it is therefore inapplicable to a mollusk. I noticed this fact when describing my *Conulus vacans* in Ann. and Mag. Nat. Hist. 1866, 3 ser., vol. xvii., p. 53; upon which Mörch proposed the name Guppya

(Journ. Conch. 1867, p. 256), on account of my having stated that the teeth of *Conulus vacans* were like those of *Testacellus*. My remark, however, only referred to the lateral teeth; for those of the median portion of the odontophore are not like the teeth of Testacellus. In 1870, Prof. Ralph Tate redescribed the genus *Guppya* (Amer. Journ. Conch., vol. v., p. 154), and I apprehend that that name, in default of a better, must stand for the group of which *C. vacans* is a member, and of which *Guppya selenkai* may be regarded as the type. The name *Stenopus* was adopted by Woodward in his Manual to replace *Nanina* and *Ariophanta;* but it is almost superfluous to say that this very doubtful improvement in nomenclature was not accepted by naturalists.

I collected a single example of a mollusk, which I take to be the *Stenopus cruentatus* of Guilding; but I cannot regard it as congeneric with *Guppya livida*. I was unable to extract the animal without injury to the shell; and having only one specimen, I was unwilling to sacrifice it. It appears to me that it is a *Zonites*, or perhaps even a *Macrocyclis*. The foot was singularly long and narrow, and of a deep yellow.

*Bulimulus stramineus* is nearly akin to *B. vincentinus;* the former is broader in its proportions, with more rapidly increasing whorls, and of a delicate transparent golden yellow, like the typical form of *B. aureolus*. I have some suspicion that *B. vincentinus* is not confined to Trinidad, as lately supposed, but is also found in S. Vincent.

I did not find *Amphibulima tigrina* (Lesueur), which is stated to be a native of S. Vincent. Judging from its similarity to *Amph. pardalina* of Dominica, which lives embedded in the thick moss on the trunks of trees on the highest mountains, I had expected to have found *A. tigrina*

on Morne Garou, the highest mountain in the island, but in this I was disappointed. It may nevertheless exist on some of the other summits.

The species which I have recorded under the name of *Succinea candeana* is also found in S. Lucia and Martinique, and appears to be identical with *S. curieri* (Guild), under which name it is mentioned in Bland's list of S. Vincent shells.

| Antilles N. of S. Vincent. | Land-Shells of St. Vincent. | Grenada. | Trinidad. | S. America. |
|---|---|---|---|---|
| ... ... | Bulimus oblongus, Müll.... ... | × | × | × |
| ... ... | „ auris-sileni, Boru ... | ... | ... | ... |
| ... ... | Bulimulus stramineus, Guild ... | ... | ... | ... |
| ... ... | * „ vincentinus? Pfeiff ... | ... | × | ... |
| ... ... | * „ undulatus, Guild ... | × | ... | ... |
| × | * „ limnoides, Fér ... | ... | ... | ... |
| × | * „ exilis, Gmelin ... | ... | ... | ... |
| ... ... | *Amphibulima tigrina, Les ... | ... | ... | ... |
| × | Succinea candeana, Lea ... ... | ? | ? | ? |
| × | Cionella lamellata, Pot. ... ... | × | × | × |
| × | Stenogyra caracasensis, Reeve ... | × | × | × |
| × | „ plicatella, Guppy ... | × | × | × |
| ... ... | Macrocyclis cruentatus, Guild ... | ... | ... | ... |
| ... ... | Guppya livida, Guild ... ... | × | × | × |
| ... ... | †Cyclotus grenadensis, Shuttl. ... | × | × | ... |
| ... ... | Helicina occidentalis, Guild ... | ... | ... | ... |

* In Bland's list, but not found by me.

† Not in Bland's list.

---

10*th April*, 1878.

Samuel Leonard Crane, Esq., M.D., M.R.C.S., President, in the chair.

William Miles, Esq., B.A. (Oxon), was elected a Member.

The following was read :—

## Obituary Notice of Henry William Caird, M.A. (Oxon).

It is my duty to notice to you this evening the great loss we have to deplore in the death of our late Vice-President, Mr. H. W. Caird.

Mr. Caird came out to this island in 1859 as one of the masters of the Queen's College, then newly established under the name of the Collegiate School. He continued to fill the same place from that time until his death, which took place on the 16th March last. He acted on two occasions as Principal of the College during the absence of the permanent holder of the office.

Mr. Caird was one of the founders of this Association, and its first Secretary. To his efforts its existence was in the first place mainly due; and the Association was no less indebted to the active interest he took in it for its continuance at a time when it had almost fallen into abeyance. He was twice President of the Association, on each occasion for two years.

Mr. Caird was a lover of the sciences; he had a good acquaintance with geology and the kindred branches of knowledge. He made several collections of insects, which, with great liberality, he presented to persons interested in entomology, in order that that department of science should be worked out in reference to this island. Unfortunately no information has reached us as to what has been done with his collections, a circumstance much to be regretted, as it may be feared that another opportunity of placing our knowledge of the insects of Trinidad on a satisfactory basis has been lost.

I feel sure that every member of the Association will join

with me in the expression of the deepest regret at the loss of our friend and fellow-worker.

---

*26th June*, 1878.

Samuel Leonard Crane, Esq., M.D., M.R.C.S., President, in the chair.

William Miles, Esq., B.A., was elected Vice-President in the place of the late Mr. Caird.

The following Donations were announced :—

"Journal of the Society of Arts," Nos. 1319—1329. *From the Society.*

"Trübner's Literary Record," Nos. 127—132. *From R. J. Lechmere Guppy, Esq.*

---

*20th November*, 1878.

William Miles, Esq., B.A., Vice-President, in the chair.

Philip Henry Nind, Esq., M.A., was elected a member.

The following officers were elected for the year 1878-9 :—

Samuel Leonard Crane, M.D., *President.*

Robert John Lechmere Guppy, F.L.S., *Vice-President.*

William Miles, B.A., *Vice-President.*

Ernest Francis, F.C.S., *Secretary and Treasurer.*

The following communications were read :—

J. On the Recent and Tertiary Species of Leda and Nucula found in the Westindies : with Notices of Westindian Shells. By R. J. Lechmere Guppy, F.L.S., F.G.S., C.M.Z.S., etc.

CONTENTS.

§ 1. Preliminary observations.
2 Species of Leda and Nucula.
§ 3. Miocene Pteropoda of Jamaica.
4. Descriptions of Molluska.

§ 1. *Preliminary Observations.*

The genus *Nucula* was created by Lamarck in 1799, for small bivalve shells having a nacreous interior and a line of numerous hinge-teeth interrupted beneath the umbo by a pit for the insertion of the ligamental cartilage. The few species known to Linné were included in his genus *Arca*. The genus *Leda* is ascribed to Schumacher, who published the name in 1817. But it was not until some twenty or thirty years ago that the name was generally adopted for the rostrated species formerly included in Nucula. Of the little group of Arcadæ formed by these two genera, D'Orbigny describes only two species in his "Mollusques de Cuba;" viz., *L. vitrea* and *L. jamaicensis*, both of which have been found in the Gulf of Paria. The same author, in his "Voyage dans l'Amerique Meridionale," mentions nine species of Leda and five of Nucula. Of these, *Nucula semiornata* and *Leda patagonica* (the latter now recorded from the Gulf of Paria), are the only ones named from the eastern side of the South American continent, the other twelve being all west coast shells, and apparently different from any Westindian or Brazilian species. Hanley gives two species as Westindian (Recent Bivalves, 1843-56), one being the *Nucula tellinoides* said to have been found at Cumana, and the other the *N. recurva* of Conrad, neither of which has occurred to me. Krebs, in his list of the Westindian Molluska (1864) does not name any species of the group.

Other general observations on the Molluska treated of in this communication will be found prefixed to the descriptions in each of the following sections: it is only necessary here for me to express the hope that the roughness of the accompanying illustrations will be pardoned on the ground that

artistic skill for the execution of such work is not to be found here. The figures are only intended to give, in conjunction with the descriptions, a fair general idea of the shells wished to be represented, and it should not be supposed that they are meant for finished drawings.

§ 2. *The Species of Nucula and Leda.*

1. *Nucula schomburgki.* Forbes (Pl. vii., f. 10).

N. schomburgki, Forbes, in Schomburgk, History of Barbados, p. 565.

N. schomburgki, Guppy, Geol. Mag., 1867, p. 500.

The likeness of this shell to *N. bivirgata*, *N. ornatissima*, and *N. cobboldiæ* was remarked by Prof. Forbes when describing it, and he gave the greater weight to its alliance with the latter. Nevertheless, to me it appears more nearly allied to *N. bivirgata*. The recent species of the small group of divaricately ornamented Nuculas, in which the above extinct species find their place, are *N. castrensis* and *N. divaricata*. Eocene, Barbados, Trinidad (Sanfernando).

2. *Nucula crosbyana* n. sp. (Pl. vii., f. 3, 3a).

Oval-elliptical, sub-equilateral, scarcely attenuated behind, thin, smooth, shining, indistinctly marked by some close concentric riblets, more visible towards the regularly curved ventral margin; ends rounded, slightly gaping, the anterior end the shortest, forming an angle with the hinge-line; umbones small, scarcely prominent; hinge-teeth about twelve before the ligamental pit and about fifteen behind it. Length, 16 mm.; height, $8\frac{1}{2}$ mill.

I received from Mr. W. O. Crosby two dead valves of this species, dredged by him in the Gulf of Paria. In shape it is

like a *Solenella*, and it partakes indeed of some of the characters of that genus, as well as of *Nucula* and *Leda*, and were it rostrated it would be referred to the latter. It is quite of a different type to the Nuculas which follow, and to those like *N. nucleus*.

3. *Nucula vieta*, Guppy (Pl. vii., f. 11).

Proc. Scientific Assoc. Trinidad, 1867, p. 174.

Geological Magazine, 1874, pl. xviii., f. 8.

A Nucula of obliquely subtriangular form, like *N. proxima* and *N. mixta*, with regular round concentric ribs. Small specimens only have occurred in the Pliocene of Trinidad, but it would not be surprising if it proved to be also a recent shell attaining greater dimensions than those we have seen, the largest of which are $3\frac{1}{2}$ mill. in height and 3 mill. in breadth.

4. *Nucula baccata*, Guppy (Pl. vii., f. 12).

Proc. Scientific Assocr. Tinidad, 1867, p. 174.

Geological Magazine, 1874, Pl. xviii., f. 7.

A Nucula of the group of *N. obliqua* and *N. similis*, somewhat similar in style to *N. vieta*, but distinguished by its less triangular form, greater size, and almost smooth surface. The margins of both species are crenulate. *N. baccata* has only hitherto been found in the Pliocene of Trinidad. Our specimens measure 7 mill. in breadth, and $5\frac{1}{2}$ mill. in height. As nearly all the shells of living species found in the Pliocene (Matura) beds of Trinidad are smaller than their living representatives, it may be anticipated that if any of those now known only as fossils are discovered to be living, the recent examples will be of larger size.

5. *Leda packeri*, Forbes (Pl. vii., f. 9).

Nucula (Leda) packeri, Forbes, in Schomburgk, Hist. Barbados, p. 565.

Leda incognita, Guppy, Geol. Mag., 1867, p. 500.

Transversely ovate, with round concentric ribs ; rostrated posteriorly ; lunule and dorsal area broad, distinct, circumscribed by the keels running from the umbones to the extremities. Length $8\frac{1}{2}$ mill., height 5 mill.

I described a single specimen obtained from the eocene of Sanfernando as a new species under the name of *L. incognita;* but I am now disposed to attribute the differences between it and the *L. packeri* of Forbes to variation and to the state of preservation of the specimens.

6. *Leda vitrea*, Orb. (Pl. vii., f. 6).

Leda vitrea, D'Orbigny, Moll. Cuba, vol. ii., p. 262, pl. xxvi., f. 27—29.

L. perlepida, Guppy, Geol. Mag., 1874, pl. xviii., f. 9.

I am inclined to think that *L. perlepida* from the Pliocene of Trinidad is identical with *L. vitrea* of D'Orbigny, of which I have dredged dead valves in the Gulf of Paria.

7. *Leda clara*, Guppy (Pl. vii., f. 4).

Leda clara, Guppy, Geol. Mag. 1874, pl. xvii., f. 1 ; 1875, p. 42.

Somewhat like *L. vitrea*, but larger and less acutely rostrated. In general shape like *L. sapotilla*, Gould.

Miocene, Jamaica.

8. *Leda acuta*, Gabb (Pl. vii., f. 8).

Leda acuta, Gabb, Trans. Amer. Phil. Soc., vol. xv., p. 255.

Distinguished from the preceding by its rather more tumid

form and its regular equal concentric riblets, which are not (at least posteriorly) parallel with the lower margin.

9. *Leda illecta*, Guppy (Pl. vii., f. 5).

Leda illecta, Guppy, Proc. Scient. Assoc. Trinidad, 1867, p. 174.

A Leda somewhat like *L. eburnea* Sow, distinguished from the preceding by its smoothness and somewhat pear-shaped form. I copy the original description: "Smooth, ovate-transverse, inequilateral, somewhat tumid on the central portion, posterior end produced into a rostrum which is almost curved upwards; hinge-line somewhat deflected upwards, and interrupted at the umbo; umbones approximated, scarcely prominent beyond the hinge-line; posterior cardinal area broad, smooth, and ill-defined." Length 10 mill., height 6 mill.

Eocene, Manzanilla, Trinidad.

10. *Leda bisulcata*, Guppy (Pl. vii., f. 7).

Leda bisulcata, Guppy, Geol. Mag. 1867, p. 500, f. 2.

This is as tumid as *L. acuta*, Gabb, but is more rostrated, the riblets are much finer, and are parallel with the margin, whilst the sulcus down the anterior end forms a good distinguishing mark. A trace of a similar sulcus may be observed in *L. jamaicensis*, whose ornamentation, however, is of a much bolder character.

Miocene, Jamaica.

11. *Leda jamaicensis*, Orb.

Leda jamaicensis, D'Orbigny, Moll. Cuba, vol. ii., p. 263, pl. xxiv., f. 30—32.

This has not been recorded as fossil. Examples dredged in the Gulf of Paria differ slightly from D'Orbigny's figure.

12. *Leda egregia* n. sp. (Pl. vii., f. 1, 2).

Lanceolate, narrow, compressed, ivory-shining, inequilateral, much rostrated posteriorly, somewhat rounded anteriorly, with numerous crowded somewhat lamellar concentric ribs, which become almost obsolete on the central portion of the valves; hinge-teeth fine and long, about 30 in the anterior and 40 in the posterior series, the two series separated by a broad triangular cartilage pit immediately beneath the small and scarcely prominent umbo; anterior dorsal margin gently curved; posterior dorsal area incurved and very distinctly bounded, covered with a dark epidermis, and bounded below by a prominent ridge upon which the concentric riblets rise into small white points; another ridge runs from the umbo down to the margin to form the lower angle of the posterior end. Length 25—40 mill., height 8—13 mill.

Intermediate between *N. tellinoides* Sow. and *N. patagonica* Orb. Several specimens dredged in the Gulf of Paria by Mr. W. O. Crosby.

13. *Leda patagonica*, Orb.

L. patagonica, D'Orb. Voy. Amer. Mer., p. 544, pl. lxxxii., f. 1—3.

This fine species in general aspect is not unlike *L. lanceolata* and *L. egregia*. It is distinguished from *L. egregia* by the flattened, not lamellar, ribs; it is less rostrated; the dorsal area is not incurved, and is narrower. The other differences are not easily described, but are readily appreciable upon a comparison of specimens. Our examples are larger than D'Orbigny's, and measure 49 mill. in length and

16 in height. Two dead valves, dredged by W. O. Crosby in the Gulf of Paria.

§ 3. The Miocene Pteropoda of Jamaica.

In my paper on the Tertiary Molluska of Jamaica, published in the *Geological Society's Journal*, August 1866, p. 281, I quoted a passage from a letter of Mr. Lucas Barrett to Dr. Woodward, in which it was stated that a marl-bed exists in that island, containing abundance of Pteropoda of the genera Cleodora, Creseis and Cuvieria. Up to the present time I have heard no more of that discovery, and we have not, I believe, any account of the specific forms found in Jamaica, except the description given by me of *Hyalea vendryesiana*. In Haiti, Gabb has discovered six species of Pteropoda, which he has named as follows:—

| | |
|---|---|
| Diacria bisulcata. | Planorbella imitans. |
| Balantium undulatum. | Atlanta rotundata. |
| Styliola sulcifera. | ,, cordiformis. |

I have received additional specimens of the tertiary fossils of Jamaica from Mr. Vendryes, and among them I find two apparently new species of Hyalea, which I take the present opportunity of describing.

1. *Hyalea vendryesiana*, Guppy.

Geol. Mag. 1874, p. 405, pl. xvii., f. 2*b* (not 2*a*).

This species belongs to the section *Diacria*, whilst the following two may be placed among the typical forms of the genus. There seems to be an error in my original description, for it does not appear that in *H. vendryesiana* the lips are everted or thickened. That character belongs to *H. digitata*, an imperfect example of which is figured with *H. vendryesiana* (fig. 2*a*). In *H. vendryesiana* the lips are

thin, straight, and projecting, and the mouth widely open. In *H. ventricosa* the lip formed by the upper valve is very much curved, so as to come quite over and hide the narrow mouth, and in *H. digitata* the lips are thickened and everted.

2. *Hyalea ventricosa* n. sp. (Pl. vii., f. 15).

Almost globular, rounded and much inflated in front: lower valve swollen; upper valve spoon-shaped, inflated, adorned by three keels or ribs radiating from the umbo to the extremely reflected and recurved lip; the central keel more pronounced and distinct, the lateral ones broader and more rounded; lateral mucrones simply angular, not pointed, terminal mucro short and pointed; mouth narrow, hidden by the protrusion of the sharp thin lip. Length $4\frac{1}{2}$ mill., breadth 4 mill.

Bears some resemblance to *H. globulosa* Rang and to *H. quadridentata* Les. in general character. In our shell the lateral mucrones are single, and there is a decided terminal mucro; the central rib is narrower and more defined than the broader rounded one on each side of it.

3. *Hyalea digitata* n. sp. (Pl. vii., f. 16).

Oblong, rather compressed; lower valve inflated; upper valve slightly convex, adorned with three nearly equal rounded radiating ridges, constricted in front, and bordered by a thickened lip; mouth narrow, lips thickened and everted; terminal mucro short, sharp; lateral mucrones scarcely produced. Length 5 mill., breadth 3 mill.

In some respects resembles *H. tridentata* Bosc. and *H. uncinata* Rang, but is not so inflated, and has shorter and less curved lateral mucrones.

## § 4. Descriptions of some Species of Westindian Molluska.

I take advantage of the present opportunity to give sketches and descriptions of five shells, two of which have been previously described, but not figured; the other three are new. Of the five, four are inhabitants of the Gulf of Paria, and the fifth is a small but curious shell from the miocene of Jamaica. *Metula lintea* and *Periploma orbicularis* were dredged in the Gulf of Paria by Mr. W. O. Crosby, of the Boston Society of Natural History. Mr. Crosby discovered not only the species mentioned in this communication as dredged by him, but several others which he kindly communicated to me, and which are of remarkable interest as being either identical with, or nearly allied to, fossils of the Westindian miocene. As the specimens referred to are all dead shells, devoid of colour, it has occurred to me as a possibility that they might have been derived from some tertiary bed at the bottom of the Gulf. An hypothesis like this, however, would be at once refuted by the finding of a single living example.

### 1. *Periploma orbicularis* n. sp. (Pl. vii., f. 13).

Suborbicular, subequilateral, somewhat compressed, thin, nacreous internally, shagreened externally by minute rugosities disposed in radiating lines, and covered with a thin epidermis; anterior side regularly rounded; posterior side somewhat produced, sinnate, and obliquely truncate; umbones prominent, fissured. Height 25 mill., length 30 mill.

Resembles the *Periploma compressa* of D'Orbigny (Voy. Amer. Merid., p. 514, pl. lxxviii., f. 19, 20), but having a greater relative height from the umbo to the margin, is more

orbicular in shape. There is also some likeness between our shell and *Anatina globulosa* Lam.

2. *Lithodomus bipenniferus* Guppy (Pl. vii., f. 14).

L. bipenniferus Guppy, Proc. Scient. Assoc. Trinidad, 1877, p. 155.

Described in my list of Molluska from the Gulf of Paria. Several species of Lithodomus have been described from the Westindies; but none that I know of possessing the peculiar characters of this shell, which appears to be most nearly allied to the *L. caudigerus* of West Africa. It is found in almost every piece of limestone and coral in the Gulf.

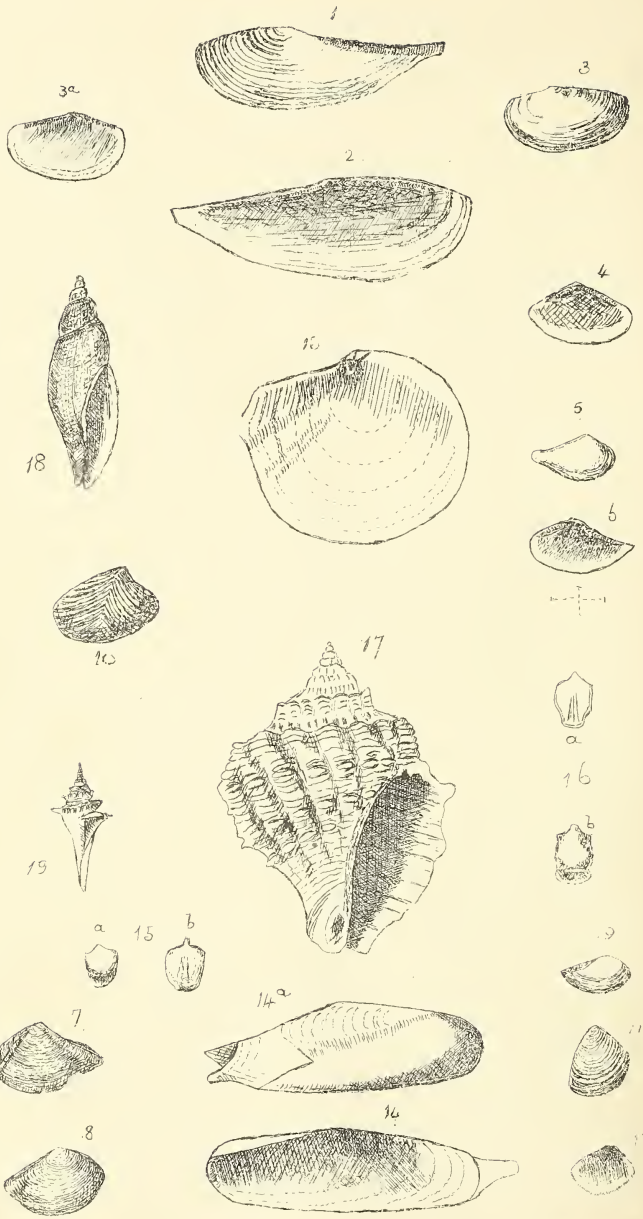
3. *Metula lintea* n. sp. (Pl. vii., f. 18).

Regularly fusiform, imperforate, cancellated by longitudinal and revolving lines—the latter stronger on the lower whorls, the longitudinal ones more evident above; spire-turreted, whorls eight, gradually increasing, slightly convex, the first two smooth, the last forming more than two-thirds of the shell; suture subcrenate, bordered, aperture elongate; columella truncate, simple or slightly twisted, covered with a thin callus spread along the body-whorl to the outer lip, which is thin and sharp, thickening backwards into a varici-form ridge. Length 27 mill., breadth 10 mill.

Dredged by Mr. W. O. Crosby in the Gulf of Paria. Allied to *M. cancellata* Gabb, of the Miocene of Haiti and Jamaica. Our single specimen is distinguished from *M. cancellata* by its very much finer ornamentation, and by the absence of varices; the thickening near the mouth showing only the incipient existence of the variciform tendency.

4. *Pleurotoma miranda* n. sp. (Pl. vii., f. 19).

Fusiform turreted, whorls about eight, angulated, narrow-


1
3a
3
2
4
18
16
5
6
10
17
a
16
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a
15
b
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14a
7
11
8
14
12

ing rapidly, and bearing a row of pointed crenate lamellar tubercles or spines on the angle, above which is a continuous plain revolving ridge; last whorl about two-thirds of the length of the shell; spire elevated, acuminate; aperture elongate, with two sinuses, one corresponding to the angle of the whorls, and the other to the ridge above it; canal long, columella smooth. From the angle of the last whorl to the end of the canal is about one half the length of the shell. Length 13 mill., extreme breadth 5 mill.

Though, on account of the keel above the angle of the whorls and the corresponding sinus of the aperture, I have provisionally described this little shell as a *Pleurotoma*, and assign it as an ally to *Pl. rotata* (Miocene Europe), I cannot overlook its likeness to *Fusus pagodus* and *F. echinatus*. It also has a striking similarity in general outline to the *Thatcheria mirabilis* of G. F. Angas (P.Z.S. 1877, p. 529, pl. liv., f. 1), which is not, indeed, so ornate as our species, and is much larger.

Miocene, Jamaica (H. Vendryes).

5. *Purpura trinitatensis*, Guppy (Pl. vii., f. 17).

Proc. Scient. Assoc. Trinidad, 1869, p. 366.

Ann. and Mag. Nat. Hist., Jan. 1875, p. 50.

EXPLANATION OF PLATE VII.

Fig. 1. Leda egregia, exterior of left valve.
„ 2. „ „ another specimen, interior.
„ 3. Nucula crosbyana, left valve, exterior; 3*a*, interior.
„ 4. Leda clara, left valve, interior.
„ 5. „ illecta, right valve, exterior.
„ 6. „ vitrea, right valve, interior; magnified.
„ 7. „ bisulcata, left valve, exterior; magnified.
„ 8. „ acuta, right valve, exterior; magnified.
„ 9. „ packeri, right valve, exterior.

Fig. 10. Nucula schomburgki, right valve, exterior.
„ 11. „ vieta, right valve ; magnified.
„ 12. „ baccata, left valve, interior.
„ 13. Periploma orbicularis, left valve, interior.
„ 14. Lithodomus bipenniferus, right valve, interior.
„ 14a. „ exterior.
„ 15. Hyalea ventricosa ; *a* lower valve, *b* upper valve.
„ 16. „ digitata ; *a* upper valve, *b* lower valve.
„ 17. Purpura trinitatensis.
„ 18. Metula lintea.
„ 19. Pleurotoma miranda.

[N.B.—The figures are all of the natural size, except where it is otherwise specified.]

## II. On a Heterocercal Fish found in the Blue Limestone Series of the Laventille Hills. By R. J. Lechmere Guppy, F.L.S., F.G.S., etc. (Pl. VIII.)

In a paper on the Blue Limestone of the Laventille Hills (Proc. Scient. Assoc. Trin., 1877, p. 109), I referred to the discovery of a fish in one of the beds of the series. I had not then seen the specimen, but it has since come into my possession, and is now exhibited to the Association. It consists of part of the vertebral column with the tail-fin of a heterocercal fish. There are about thirty vertebræ present, and the rays of the tail are about fifteen in number. There are traces of fine needle-like spines extending backward from the vertebræ near the tail. The length of the specimen is nearly six inches (15 centimetres) ; the anterior portion is nearly straight, the posterior part slightly curved. The thickness of the stoutest vertebræ is 5 millimetres ; they are nearly all of the same dimensions up to the origin of the caudal fin, whence they rapidly taper off to its extremity.

The specimen came from the Piccadilly quarry on the east side of Portofspain. It is exposed on the surface of a thin

dark-red micaceous sandy lamina, the usual parting between the beds of limestone in the quarry named. There is not a vestige of dermal tissue, or of any other portion of the fish, except those described above. (See Plate VIII.)

Notwithstanding the meagreness of the characters afforded by the specimen, I venture to assign it a provisional name, and a place among the Ganoid fishes, as *Acanthodes elongatus*. The genus *Acanthodes*, to which I refer our fossil, is characteristic of Devonian and carboniferous rocks; and, supposing my determination to be near the truth, the additional evidence thus furnished is in favour of the view taken by me in the paper referred to at the commencement of this notice as to the probable age of the Blue Limestone series, and its entire distinctness as a formation from the mica and talc-schists and sandstones, the clayslate, quartzite and crystalline limestones of the Caribbean group.

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18*th January*, 1879.

William Miles, Esq., B.A., Vice-President, in the chair.

Mr. Lechmere Guppy brought under the notice of the Association the desirability of extending its sphere of action by including within its functions those of an agricultural society. The Association had always considered agriculture as well as manufacture within the range of the subjects to be inquired into and discussed at the meetings, and members would recollect on how many occasions such topics have been before the Association. In addition to discussions not recorded in the Proceedings, the Association has published papers on the manufacture of sugar, the growing of cacao, and the rearing of stock. It was proposed now to invite

those interested in planting and manufacture to join in giving a practical shape to the efforts of the Association for the improvement of agricultural and manufacturing operations. It was suggested that the title of the Association might be altered to the "Scientific and Agricultural Association of Trinidad," and that two sections should be formed, to be called respectively the "Scientific and General Section" and the "Agricultural Section." Members on election would state to which section they desired to belong, and the names of the members belonging to each section would be arranged in a separate list. While the members of both sections would enjoy all privileges of attending meetings, receiving the published papers, voting, etc., the contributions of the members of the agricultural section would, after deducting their share of the expenses of printing, meetings, etc., be devoted to such objects alone as the members of that section might determine, and they might have the power of raising among themselves such further contributions as they might think fit for the purpose of holding industrial or agricultural exhibitions, ploughing matches, or prizes for agricultural or manufacturing objects. If the principle of this scheme were accepted, the details would of course be matter of arrangement and discussion.

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*4th February*, 1879.

William Miles, Esq., B.A., Vice-President, in the chair.

A Telephone and a Microphone, kindly lent by J. Edward Tanner, Esq., M.I.C.E., were exhibited, and their construction and application illustrated.

*19th February*, 1879.

William Miles, Esq., B.A., Vice-President, in the chair.

Robert Gervase Bushe, B.A., and J. B. Hutton, were elected members.

The following papers were read :—

"On a Chemical Examination of Blighted Sugar-canes, and of the Soil in which they were Grown." By Ernest E. H. Francis, F.C.S., F.L.C.

I have the honour to bring before the notice of the Association this evening some preliminary results of a chemical investigation into the nature of a disease affecting the sugar-cane in this island, with the object of promoting discussion on the important question of the cause and cure of the malady.

The disease is a formidable one, since it affects whole fields, without a single cane escaping, and results in a withering and atrophy of the plant. It is characterised by the production of rust-coloured spots, and bears some similarity to —it may be even identical with—the cane "rust" which prevails in Australia and other islands of the southern hemisphere.

So few facts are known respecting these constitutional diseases of cane, that the problem of their cause and cure is not easy of solution. The ravages of insects, such as borers, aphes (or blast), *pou blanc*, ants, and jumper flies, are treated of in books devoted to cane culture, and trenchant remedies are in vogue, such as the application of caustic lime, carbolic acid, etc., which doubtless fulfil their purpose admirably; but obscure maladies, such as the degeneracy or "sickness of flacq," which made such havoc amongst the crops of Mauritius, the cane "rust" in Australia, and the various

fungoid affections of the plant, have received but scant attention. Within the last few years, however, some important steps have been taken to ascertain the nature of these diseases, and some laborious researches on the subject have been published by certain writers, notably by Professor Liversedge, Dr. Bancroft, and Mr. Staiger, in Australia.

It appears to be a matter of tolerable certainty that these diseases are caused either by the absence or deficiency of some necessary ingredient in the cane soils; or, on the other hand, by the presence of some noxious matter. But much patient investigation, involving minute analysis of the ash constituents of the various species of cane, and of the different soils, and comparisons of analytical data from every source, is needed before definite conclusions can be drawn respecting the influence exercised by the presence or absence of any particular constituent.

The samples of diseased canes which I examined were three in number, each from a separate field, and belonging to Orange Grove estate. They consisted of three distinct stoles, and came into my hands in an apparently fresh condition, with their roots and adherent earth enclosed in canvas bags. The canes of samples No. I. and No. III. were approaching maturity, No. II. was still green.

No. I. sample included three fairly grown canes, a dwarf one, and a young shoot. The longest cane measured nearly six feet, but the upper third was little more than dry woody fibre scarcely $\frac{1}{8}$ in. in diameter. All the canes in this stole presented a dull and shrivelled appearance, the nodes being prominent, and the silicious covering of the internodes corrugated longitudinally. The length between the nodes varied more than in healthy canes, the shortest spaces being usually

near the middle of the cane. Many of the leaves were dead, others were brown and dry at the apex only; but all near the base exhibited patches of rust-red colour, in places merging into purple.

No. II.; the best cane in this stole, was only 33 in. in length, but averaged $1\frac{3}{8}$ in. in diameter, and presented a more glossy exterior than any other amongst the samples. It showed, however, a marked variation in the length of the internodes, the shortest, near the middle, being only $1\frac{1}{3}$ in., while near the root and head internodes measured respectively $4\frac{1}{2}$ and $4\frac{5}{8}$ in. There were several bored holes of various sizes in this cane. The leaves were green, but exhibited numerous spots, some transparent, and others in process of conversion into the red marks before referred to. The other two canes in this stole presented a most unhealthy appearance.

No. III. sample bore a general resemblance to the stole No. I., but the longest cane only measured 4 ft. 8 in., and the other two not much more than half this length. The exterior of these canes was dull and wrinkled, and the leaves nearly all dead.

The borer was found in most of the plants in different stages of metamorphosis, fragments of the borer butterfly being plentiful, the insect having apparently been attacked by ants. A careful microscopical examination of the canes was made for fungi. A white powdery substance resembling a fungus, small tufts of which were often met with on the upper surface of the leaf near the base, proved to be collections of cane fibre and *débris*. A few threads of mycelium were perceived, but nothing of sufficient significance to account for the ill-health of the plant. A red colouring matter extensively affected the interior substance of the cane

where it had been attacked by the borer. When the canes were cut up, the whole cellular structure became of a dark red. This colouring matter was found to be soluble in alcohol, but insoluble in water, although it appeared to be in solution in the cell contents when sections of the coloured portion were examined under the microscope. The colouring matter is probably due to the presence of a bacterium or fungus similar to the *monos prodigiosa* of Ehrenberg.* The roots were free from mildew, and appeared quite natural.

As it was manifest that the mere physical examination of the canes furnished no clue to the cause of the disease, inasmuch as the ravages of the parasites found were quite inadequate to have caused the decay of the plants—and as it is a matter of doubt whether parasites, in any case of blight, are the primary cause of the disease, or are merely attendant on the disordered condition of the plant—a complete chemical examination was proceeded with, and gave the following results :—

ANALYSIS OF CANES AND CANE ASH.

*Proximate Analysis of Cane.* 100 parts of cane contain—

| | I. | II. | III. |
|---|---|---|---|
| Water ... ... | 78·66 | 82·91 | 81·81 |
| Crystallizable sugar | 10·13 | 3·40 | 2·42 |
| Glucose ... ... | 1·46 | 2·20 | 4·65 |
| Ash ... ... ... | 0·33 | 0·33 | 0·34 |
| Fibre, etc. ... ... | 9·42 | 11·16 | 10·78 |

* A curious spherical bacterium, which infects eatables, and gives them a red colour. Food placed under a glass shade along with *monos prodigiosa* turned red in two or three days. When seen under a microscope with a magnifying power of 1,000 diameters, it appears to consist of round bodies filled with a red substance, and swimming in a red fluid. The colouring matter is insoluble in water, and nearly so in ether, but dissolves in alcohol with a blood-red colour.—*Arch. Pharm.* (3) v. 19—24.

| *Analysis of Cane-ash.** | 100 parts of dry ash contain— | | |
|---|---|---|---|
| Silicic anhydride ... | 31·82 | 40·21 | 32·09 |
| Sulphuric anhydride | 13·84 | 18·91 | 11·97 |
| Phosphoric „ | 7·07 | 4·98 | 7·72 |
| Chlorine ... ... | 2·78 | 2·21 | 2·20 |
| Ferric oxide ... | 1·09 | 1·51 | 1·86 |
| Calcium oxide ... | 7·06 | 8·05 | 7·41 |
| Magnesium oxide ... | 6·72 | 11·56 | 5·85 |
| Potassium „ ... | 26·92 | 10·25 | |
| Sodium „ ... | 0·45 | 0·51 | 31·10 |
| Carbonic anhydride, Manganese oxide, etc. | 2·87 | 2·28 | |
| | 100·62 | 100·50 | 100·50 |
| Deduct oxygen = to chlorine ... ... | 0·62 | 0·50 | 0·50 |
| | 100·00 | 100·00 | 100·00 |

By the above analysis a considerable deficiency in the amount of silicic anhydride (silica) is shown. The quantity of sodium oxide (or soda) also is remarkably small, and in one case, at all events, the phosphoric anhydride is below the average. The remaining constituents call for no particular comment. To afford *data* for comparison, the following analyses of healthy canes, and of normal cane ash are given.

* The analysis of cane ash was carried out as follows :—The cane, detached from the stole and stripped of leaves, was cut in small pieces, and incinerated in a porcelain dish over a large spirit lamp, a glass cylinder being supported above the dish to increase the draught. Complete calcination was subsequently effected in a platinum basin. A weighed quantity of the dry ash was then evaporated with sodium hydrate solution to decompose the silicates, treated with hydrochloric acid, and the estimation of the constituents proceeded with in the usual way. To determine the amount of alkalies, a further weighed quantity of ash was decomposed with hydrofluoric acid, according to the method of Berzelius.

### Proximate Analysis of Cane.

100 parts contain (according to Peligot and Dupuy)—

| | | |
|---|---|---|
| Water ... ... ... ... ... ... | 72·1 | 72·0 |
| Total sugar ... ... ... ... ... | 18·0 | 17·8 |
| Ash<br>Fibre, etc. ... ... ... ... ... | 9·9 | 0·4<br>9·8 |

### Composition of Cane Ash. (Calculated from the analyses of Stenhouse.)

100 parts contain—

| | | | | |
|---|---|---|---|---|
| Silicic anhydride ... ... | 46·46 | 41·37 | 46·48 | 50·00 |
| Sulphuric ,, ... ... | 4·65 | 10·93 | 7·52 | 6·40 |
| Phosphoric ,, ... ... | 8·23 | 4·59 | 8·16 | 6·56 |
| Chlorine ... ... ... | 9·11 | 5·55 | 2·40 | 2·38 |
| Ferric oxide... ... ... | 0·00 | 0·00 | 0·00 | 0·00 |
| Calcium oxide ... ... | 8·91 | 9·11 | 5·78 | 5·09 |
| Magnesium oxide ... ... | 4·50 | 6·92 | 15·61 | 13·01 |
| Potassium ,, ... ... | 15·30 | 21·64 | 11·93 | 13·69 |
| Sodium ,, ... ... | 4·88 | 1·13 | 2·66 | 3·41 |
| Carbonic anhydride, manganese oxide, etc. | 0·00 | 0·00 | 0·00 | 0·00 |
| | 102·04 | 101·24 | 100·54 | 100·64 |
| Deduct oxygen equal to chlorine. | 2·04 | 1·24 | 0·54 | 0·54 |
| | 100·00 | 100·00 | 100·00 | 100·00 |

The mean quantity of silicic anhydride shown by the above analysis is 45·84 per cent., whereas the mean percentage in the ash of the diseased samples is only 36·01—a difference of nearly 10 per cent. Professor Liversedge, in a report on the sugar-cane disease in Queensland, shows an extraordinary deficiency of silicic anhydride in the ash of the diseased plants compared with those that were healthy (*Sugar Cane*, vol. viii., p. 544). He found in diseased rappœ cane 13·60 per cent. of silicic anhydride; in healthy rappœ 50·47 per cent. And

again, in diseased trœbæ 11·36 per cent.; in healthy trœbæ 22·82 per cent. silicic anhydride. The quantity of silicic anhydride in the last species of cane appears to be much below the average, but the fact remains that the diseased cane contained only half as much as the healthy one.

An analysis of the soil in which the diseased canes submitted to me were grown gave the following results :—

### Analysis of Air-dried Soil.

The soil was a heavy clay. It contained neither stones nor gravel, and only 7·35 per cent of sand.

100 parts contain—

| | |
|---|---|
| Soluble silicic anhydride ... ... ... ... | 0·0007 |
| Sulphuric anhydride... ... ... ... ... | 0·0364 |
| Phosphoric „ ... ... ... ... ... | 0·1164 |
| Chlorine ... ... ... ... ... ... | 0·0163 |
| Calcium oxide... ... ... ... ... ... | 0·3613 |
| Magnesium oxide ... ... ... ... ... | 0·2688 |
| Ferric „ ... ... ... ... ... | 4·0683 |
| Iron black „ ... ... ... ... ... | 1·3456 |
| Aluminium „ ... ... ... ... ... | 2·6827 |
| Sodium „ ... ... ... ... ... | 0·0443 |
| Potassium „ ... ... ... ... ... | 0·0987 |
| Water ... ... ... ... ... ... ... | 5·3900 |
| Organic matter, loss, etc. ... ... ... ... | 2·9002 |
| Clay, etc., insoluble in hydrochloric acid... ... | 82·6740 |
| | 100·0037 |
| Deduct oxygen equal to chlorine ... ... ... | 0·0037 |
| | 100·0000 |

| | |
|---|---|
| Organic matter soluble in water ... ... ... | 0·3050 |
| Mineral „ „ „ ... ... ... | 0·1900 |
| Chlorine in aqueous solution ... ... ... | 0·0163 |
| Sulphuric anhydride... ... ... ... ... | 0·0209 |
| Total organic matter, ammonia, etc. ... ... | 7·7800 |

| | |
|---|---|
| Specific gravity of soil ... ... ... ... | 2·3554 |
| One cubic foot of the soil weighs ... ... | ... 146·79 lbs. |
| One acre to a depth of 6 inches weighs ... | 3,197,086 lbs.* |

One acre, weighing say three million pounds, contained the following quantities of the more important constituents :—

| | |
|---|---|
| Silicic anhydride (soluble) ... ... ... | 21 lbs.† |
| Phosphoric anhydride ... ... ... ... | 3,492 „ |
| Calcium oxide ... ... ... ... ... | 10,839 „ |
| Magnesium „ ... ... ... ... ... | 8,064 „ |
| Sodium „ ... ... ... ... ... | 1,329 „ |
| Potassium „ ... ... ... ... ... | 2,961 „ |

For comparison with the above figures the following computations of the quantities of those ingredients in home soils from the Westindies (Antigua) have been made from the analysis of Dr. Angus Smith, F.R.S. (*Sugar Cane*, vol. i., p. 3).

*Three million pounds of soil contained the following numbers of pounds of constituents soluble in hydrochloric acid :—*

| No. | Silicic Anhydride. | Phosphoric Anhydride. | Calcium Oxide. | Magnesium Oxide. | Sodium Oxide. | Potassium Oxide. |
|---|---|---|---|---|---|---|
| 1. | 18399 | 263 | 29097 | 2993 | 6441 | 169 |
| 2. | 2662 | — | 37187 | 6753 | 7657 | — |
| 3. | 3814 | — | 52506 | 9285 | 9319 | 1145 |

* This estimate refers only to the weight of an acre of the soil free from porosity—*i.e.*, in a perfectly solid mass. The above extent of soil, as it exists naturally in its comparatively loose state, would weigh much less, say from 2,000,000 to 2,500,000 lbs.

† The determination of the amount of soluble silicic anhydride was carefully performed twice. In the first case the hydrochloric acid solution of 300 grammes of soil was evaporated to complete dryness, heated again with hydrochloric acid in the usual way, and the silicic anhydride collected on a filter and weighed. Its weight was only 0·002 gramme. The experiment was repeated on the hydrochloric extract of 50 grammes of soil, but the silicic anhydride obtained (if any) was unweighable.

| No. | Silicic Anhydride. | Phosphoric Anhydride. | Calcium Oxide. | Magnesium Oxide. | Sodium Oxide. | Potassium Oxide. |
|---|---|---|---|---|---|---|
| 4. | 19440 | 151 | 73601 | 5944 | 5252 | 1335 |
| 5. | 4303 | 234 | 77918 | 7614 | 14804 | 778 |
| 6. | 4953 | 288 | 37628 | 5064 | 3909 | 489 |
| 7. | 4107 | 178 | 62031 | 4411 | 8681 | 59 |
| 8. | 10518 | 492 | 137309 | 14431 | 5689 | 1140 |
| 9. | 7830 | 1270 | 157964 | 3739 | 4776 | 1129 |

Dr. Smith remarks that the above soils seemed, from their physical condition, to be excellent; but to be considerably exhausted of their valuable chemical constituents. He considered lime (calcium oxide) or manuring needful. It will be noticed how deficient in calcium oxide silicic anhydride and sodium oxide in comparison with these is the soil under examination.

The following table shows the quantities of the same substances contained in 3,000,000 lbs. of average agricultural soils calculated from numerous analyses made by several chemists under the direction of Magnus (Ann. der Landwirthschaft, xiv. 2):—

| | |
|---|---|
| Silicic anhydride (soluble) ... ... ... | 13,440 lbs. |
| Phosphoric anhydride ... ... ... ... | 5,160 „ |
| Calcium oxide ... ... ... ... ... | 26,850 „ |
| Magnesium „ ... ... ... ... ... | 7,860 „ |
| Sodium „ ... ... ... ... ... | 4,830 „ |
| Potassium „ ... ... ... ... ... | 6,630 „ |

As an example of a soil of extreme fertility may be given the *Tchornoi Zem*, or black earth of central Russia. In it graminaceous plants flourish with unexampled luxuriance. Its extent is about 60,000 square geographical miles, and this area sustains twenty millions of people, in addition to exporting annually fifty million bushels of corn. In 3,000,000 lbs. of this earth there are contained of—

| | |
|---|---|
| Silicic anhydride ... ... ... ... | ... 225,000 lbs. |
| Calcium oxide ... ... ... ... | ... 78,000 „ |
| Magnesium „ ... ... ... ... | ... 28,500 „ |
| Potassium „ ... ... ... ... | ... 174,300 „ |
| Sodium „ ... ... ... ... | ... 69,300 „ |

A consideration of the facts here set forth leads to the following conclusions respecting the disease in the canes at Orange Grove estate. Based as they are, however, on very limited analytical data, they are not necessarily intended to apply to other instances or to account for the disease generally. Respecting the canes, it has been shown that they exhibited great irregularity of growth, as manifested by the variation in length of the internodes, that they were stunted and of a dull and wrinkled exterior, all indicative of defective nutrition. The analysis of the ash proved them to be deficient in soda, phosphoric acid, and especially in silica. Analysis of the soil in which the plants were grown showed it to be poor and infertile. Its physical condition was bad, as it consisted almost wholly of clay; no stones nor gravel, and only about 7·35 per cent. of sand being present. It is wofully deficient in phosphates, and in calcium, potassium, and sodium salts, while silicic anhydride, in a soluble form, is almost absent. On the other hand, the soil yields a quantity of black oxide of iron—a substance supposed to exert an injurious action on the roots of plants, and to be chiefly concerned in the production of a sour condition in land. Now it is highly probable that the defective assimilation of the plants may have been owing to the general poverty of the land, or else to the presence of the prejudicial black oxide of iron; but it is equally probable that the absence of silicic anhydride in a soluble form is at the root of the mischief, for it is an established

fact that the sugar-cane and the grass tribe generally will not thrive where silicic anhydride is not present in an assimilable form. Much remains to be done, however, before any definite conclusions can be drawn; but it is to be hoped that further investigation will lead to the discovery of the true cause of the disease.

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16*th July*, 1879.

Robert J. Lechmere Guppy, Esq., F.L.S., Vice-President, in the chair.

Henry Ludlow, Esq., B.A., was elected a member.

Mr. Ernest Francis, Secretary of the Association, being about to proceed to British Guiana as Government chemist of that colony, a vote of thanks was unanimously accorded to him for his services to the Association, and he was elected a corresponding member.

The following paper was read:—

On Common Salt as a Poison to Poultry. By Ernest Francis, F.C.S.

On the Fossil Echinodermata of the Westindies. By R. J. Lechmere Guppy, F.G.S., etc., etc.

(*Abstract.*)

The author stated that in 1868-9 Professor P. T. Cleve, of the University of Upsala, travelled in the Westindies and investigated the geology and mineralogy of several of the islands, an account of which he published in 1870. He made collections of fossils, among which was a fine series of echinoderms from the islands of S. Barts and Anguilla. These were studied by M. Cotteau, who distinguished thirty-

three species, all of which were carefully described and delineated in a paper published in 1875. By the kindness of Professor Cleve, the collection had come into the possession of the present author, who now took the opportunity of exhibiting the specimens, and of presenting some observations upon them. A very large addition had now been made to our knowledge of the tertiary echinoderm-fauna of the West-indies, and strong support was thereby given to the determination, previously made, of the relative ages of the S. Barts and Anguilla beds, as Eocene and Miocene respectively. The author concluded with a reference to the paleozoic and mezozoic echinoderms of the Caribean area, which, though of great interest, were known chiefly from imperfect material.

*List of the Species.*

1. Cidaris melitensis, Wright.

C. melitensis, Wright (as of Forbes) Ann. and Mag. Nat. Hist., 1855, p. 7, pl. iv. f. 1.

C. melitensis, Guppy, Journ. Geol. Soc., vol. xxii., p. 297.

C. melitensis, Cotteau, Description des Echinides Tertiaires des Iles S. Barthélemy et Anguilla (Kongl. Svenska Vetenskaps-Akademiens Handb., band 13, No. 6) 1875, p. 8, pl. i., f. 1—10.

I should include under this name *Cidaris cleri*, Cott. (pl. i., f. 15, 16) and *C. anguillæ*, Cott. (pl. i., f. 17, 18). It is well known that some cidarids have two different kinds of spines; and in the matrix containing the specimen of *C. anguillæ* is one broken example of the usual form figured by Cotteau (pl. i., f. 9, 10) as the spine of *C. melitensis*. On the tablet containing the three original examples of *C. melitensis*

procured by myself from Anguilla I affixed, in 1865, a specimen of a spine identical with *C. anguillæ*, Cott.

Miocene, Anguilla.

2. **Cidaris loveni**, Cott.

Cotteau, Echinides tertiaires de S. Barts and Anguilla, p. 10, pl. i., f. 11—14.

Though very near to *C. melitensis*, this species appears to be characterized by good and permanent differences.

3. **Echinometra prisca**, Cotteau.

Cotteau, Echinides tertiaires, p. 12, pl. i., f. 19—27.

The specimens are similar in all respects to those recorded by me (Journ. Geol. Soc., vol. xxii., p. 299), as *Ech. acufera*, and perhaps differ sufficiently from the recent form to be under the circumstances entitled to a recognition as of specific rank.

4. **Echinoneus minor**, Leske.

Cotteau, Echinides tert., p. 14, pl. i., f. 28—30.

M. Cotteau does not give a specific name to this. It is probably the same as the *Ech. cyclostomus* of my paper, for which, however, the name Ech. minor may be preferable.

5. **Clypeaster antillarum**, Cotteau.

Cotteau, Echinides tert., p. 15, pl. ii., f. 1—3.

In M. Cotteau's paper this is stated to be from Anguilla, but the label assigns the species to Portorico, and I am inclined to the belief that the latter is correct.

6. **Clypeaster concavus**, Cotteau.

Cotteau, Echinides tert., p. 16, pl. ii., f. 4—8.

In my account of the Westindian fossil Echinidæ I considered this to be the *Clyp. ellipticus* of Michelin. Cotteau disagrees with this view, and gives the name of

*Cl. concavus* to the species. Among my original specimens from Anguilla are some which approach more nearly to the figure of *Cl. ellipticus* given by Michelin than the example figured by Cotteau does; and I am not at all sure whether upon an examination of a large series my first determination may not ultimately be adopted.

7. **Sismondia antillarum**, Cotteau.

Cotteau, Echinides tert., p. 17, pl. iii., f. 1—4.

Eocene, S. Barts.

8. **Sismondia anguillæ**, Cotteau.

Cotteau, op. cit., p. 18, pl. iii., f. 5—8.

Miocene, Anguilla.

9. **Echinolampas ovumserpentis**, Guppy.

Journ. Geol. Soc., vol. xxii., p. 300, pl. xix., f. 4—6.

Cotteau, Echinid. tert., p. 20, pl. iii., f. 13—21.

I am inclined to regard *Ech. antillarum*, Cotteau (p. 19, pl. iii., f. 9—12), as a form of this species.

Eocene, S. Barts (also Trinidad).

10. **Echinolampas clevei**, Cotteau.

Cotteau, Echinid. tert., p. 23, pl. iv., f. 1—5.

Apparently a very distinct form. Eocene, S. Barts.

11. **Echinolampas lycopersicus**, Guppy.

Journ. Geol. Soc., vol. xxii., p. 300, pl. xix., f. 8.

Cotteau, Echinid. tert., pl. iii., f. 22—26.

I regard *Ech. anguillæ* (Cotteau, p. 24, pl. iv., f. 6—8) as merely an unusual form of this species.

Miocene, Anguilla.

12. **Echinolampas semiorbis**, Guppy.

Journ. Geol. Soc., vol. xxii., p. 299, pl. xix., f. 7.

Cotteau, Echinid. tert., p. 24, pl. v., f. 1, 2; and pl. vi., f. 1. Miocene, Anguilla.

13. Echinanthus antillarum, Cotteau.

Cotteau, Echinid. tert., p. 26, pl. iv., f. 9—12.

Eocene, S. Barts.

14. Schizaster (Periaster) elongatus, Cotteau.

Cotteau, Echinid. tert., p. 27, pl. v., f. 6.

Eocene, S. Barts.

15. Schizaster subcylindricus, Cotteau.

Cotteau, Echinid. tert., p. 31, pl. v., f. 14—17.

I feel quite unable to separate *Sch. antillarum* (Cotteau, p. 28, pl. v., f. 3—5) from this species. The points of difference noted by Cotteau are subject to great variation in the species of this group, and cannot usually be depended on for specific characters.

Eocene, S. Barts.

16. Schizaster scillæ, Desm.

Guppy, Journ. Geol. Soc., vol. xxii., p. 301.

The *Schizaster loveni* of Cotteau (p. 29, pl. v., f. 9—13) is the same as the species recorded by me under the above name. The specimen called *Sch. clevei* (Cotteau, p. 29, pl. v., f. 7, 8) appears to be a somewhat abnormal form of the same.

Miocene, Anguilla.

17. Agassizia clevei, Cotteau.

Cotteau, Echinid. tert., p. 33, pl. vi., f. 2—10.

The genus *Agassizia* is represented in the existing seas by two species only, so far as known, one found on the west coast of South America, the other in the Antilles. The species under notice is interesting as being the only echinoderm known to be found in both the Miocene and Eocene of the Westindies.

18. **Prenaster loveni**, Cotteau.

Cotteau, Echinid. tert., p. 34, pl. vi., f. 11—15.

It seems to be straining generic distinctions rather tightly to separate *Prenaster* from *Agassizia;* but it is to be feared that many authors carry subdivision to an excessive length among echinoderms.

Eocene, S. Barts.

19. **Brissus exiguus**, Cotteau.

Cotteau, Echinid. tert., p. 35, pl. vi., f. 16, 17.

The examples of this species recorded by me in 1866 (Journ. Geol. Soc., vol. xxii., p. 301) as *Br. dimidiatus* Ag. (= *unicolor* Klein) were much larger and in better preservation than the single specimen of Cleve's collection. I leave the species under the name given to it by Cotteau, though I have doubts as to the possibility of finding grounds for a clear specific distinction between it and the recent form.

20. **Brissopsis antillarum**, Cotteau.

Cotteau, Echinid. tert., p. 37, pl. vi., f. 19—25.

Miocene, Anguilla.

21. **Macropneustes antillarum**, Cotteau.

Cotteau, Echinid. tert., p. 39, pl. vii., f. 1—3.

Eocene, S. Barts (also Cuba).

22. **Macropneustes clevei**, Cotteau.

Cotteau, Echinid. tert., p. 40, pl. vii., f. 4—7.

Miocene, Anguilla.

For these two species, and for another one found in the Pyrenees, Cotteau has created a new genus, *Peripneustes.*

23. **Plagionotus loveni**, Cotteau.

Cotteau, Echinid. tert., p. 41, pl. viii., f. 7, 8.

The genus *Plagionotus* appears to be scarcely distinct from *Eupatagus*.

Eocene, S. Barts.

24. **Eupatagus antillarum**, Cotteau.

Cotteau, Echinid. tert., p. 43, pl. vii., f. 7 –11.

Eocene, S. Barts.

25. **Eupatagus clevei**, Cotteau.

Cotteau, Echinid. tert., p. 44, pl. viii., f. 1—4.

Under this name I must also include *E. grandiflorus* (Cotteau, p. 45, pl. viii., f. 5, 6).

Eocene, S. Barts.

26. **Asterostoma cubense**, Cotteau.

Cotteau, Echinid. tert., p. 46.

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For the names of the Westindian Fossil Echinodermata, not mentioned in the above list, see Geol. Mag. 1874, p. 444, and Proc. Scientific Assoc. Trinidad, vol. i., p. 165. For a reference to the paleozoic species, see Proc. Scient. Assoc. Trinidad, vol. ii., p. 108 (Dec. 1877).

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27*th October*, 1880.

## On the Industry of Beetroot Sugar. By Adolf Urich, Ph.D.

The industry of beet-sugar in Europe has grown to such an extent lately, that not only cane-sugar is nearly expelled from beet-producing countries, but that the rapidly increasing export of beet-sugar threatens the very existence of cane-sugar industry.

The production of beet-sugar in Europe was 1,574,000

tons, for the crop 1878-79; and is estimated by Mr. Licht to be 1,625,000 tons for the crop 1880-81, out of which Germany produced about 550,000 tons; France, 330,000 tons; Austria-Hungary, 450,000 tons; Russia, 200,000 tons. Germany consequently occupies now the first rank in beet-sugar industry, as regards the quantity produced, and the highest return of sugar obtained from the raw material. Nothing shows better the superiority of a method of manufacture than a comparison of the figures obtained in practice. I quote from personal experience the results obtained in a German beet-sugar factory in the crop 1878-79. One will find them better than those of the cane-sugar usines (with very few exceptions), notwithstanding the greater richness of cane-juice in saccharine matter. This German usine was founded on shares, with a capital of £50,000, with a capacity to work up two hundred tons of beetroots in twenty-four hours. The juice was extracted out of the sliced beets by "diffusion" in such a complete manner that the residues showed only fourth-tenths per cent. of saccharine matter; a great difference with the megass of the cane, where 10, even 15, per cent. of sugar is left!

Diffusion means the systematical exhaustion of the thinly sliced beets in a diffusion battery, composed of eight to ten iron vessels, with water under action of heat. This process used now in 85 per cent. of the German and Austrian factories, and beginning to extend in France, has perhaps a high future in the manufacture of cane-sugar. Certainly the higher return in sugar would balance the increased consumption of fuel required to evaporate the water added, besides the difficulty to slice the cane thin enough and to dry the wet megass again.

The manipulation of the beet-juice was similar to that used for the cane-juice, only the use of triple effects and filtration over animal charcoal was indispensable. The molasses from the first jet (product) were re-boiled; the molasses from the second jet purified by Dubrunfaut's process, called "Osmose" (diffusion through parchment paper in contact with water), and gave a third crystallisation of sugar, polarising 92 per cent. By these means the following average figures of a whole crop in 1878-79 were obtained: Beets worked up, 25,750 tons; polarisation of the beets, 12 to 17 per cent.; return in crystallised sugar, first jet, 2,301 tons, polarising 96 per cent. = 8·93 per cent. from the weight of the beets; second jet, 230 tons, polarising 94 per cent. = 0·89 per cent.; sugar obtained by osmose, 225 tons, polarising 92 per cent. = 0·87 per cent.; total 2,756 tons, = 10·7 per cent. You will see that from the 12·17 per cent. of saccharine matter of the beets, 10·7 per cent. were obtained and crystallised. In shape of masscovite 11·34 per cent. were obtained, consequently there was only a loss of 0·83 per cent. To produce one ton of sugar, 9·35 tons of beets were required, or 100 tons of beets yielded 10·7 tons of sugar. Such results are only surpassed by a very few usines, as S. Madeleine, where 9·5 per cent.* of first sugar have been obtained.

In 1872, the average return of the fifteen usines of Martinique was only 7·86 of sugar (report by R. H. Burton). In 1879, one of the usines in that island obtained 7·25 per cent.; and in 1880, after the introduction of Faure's "Défibreur" (which increased the return of the mill in juice to 80 per cent.), 8·35 per cent.

* From the weight of the canes.

In general, cane-sugar estates working with vacuum pans may get 8 to $8\frac{1}{2}$ per cent. sugar, whilst common process estates hardly yield more than 6 to 7 per cent., and this by a richness of the canes of 15 to 18 per cent. in saccharine matter!

The average return of the German beet factories is not so high as in the factory mentioned above, the beets polarising only $11\frac{1}{2}$ per cent.; it was 8·65 per cent. of sugar out of 100 parts of beets, or one ton of sugar required 11·56 tons of beets (average of the last nine years). Better results were obtained in 1874-75, when 100 tons of beets yielded 9·3 tons of sugar and 3·54 tons of molasses, or one ton of sugar = 10·75 tons of beets.

In France, where less care of the cultivation of the beet-root has been taken, the return in sugar out of 100 tons of beets is 5·7 tons.

The cost of production of one ton of sugar in Germany was £30 8s. for the crop 1878-79, including the price of the beets = 20s. to 25s. per ton, and the government tax = 16s. per ton of beets worked up. The cost of working one ton of beets into sugar amounted to £2 16s. In the cited factory, the former have been only £23 7s. 6d., the latter £2 10s. These £2 10s. consist of—cost of one ton of beets, £1 2s.; government tax, 16s.; wages, 3s.; fuel, 2s.; amortisation and interests, 4s.; sundries, 3s.; total, £2 10s. Sundries mean salaries, fire insurance, repairs, light, new machinery, etc. These figures multiplied with 25,750 = tons of beets worked up, give the expenses of the whole year: 25,750 tons of beets, £28,325; government tax, £20,600; wages, £3,862 10s.; fuel, £2,575; amortisation and interests, £3,862 10s.; total, £64,375. The clear profit of that year was £20,000.

There is not much difference between the cost of production of cane and of beet sugar. In Demerara the cost of one hogshead of sugar is estimated at £15 to £20, whilst for Germany we have an average of £21 14s. 6d., and for the mentioned factory £15 18s. (£9 8s. being deducted for drawbacks).

If we inquire into the cause of the prosperity of the beet-sugar industry, we have to find it in the centralisation of the small estates into usines ; in the separation of the agriculture from the manufacture, the former still being interested in the financial results of the latter ; in the continuous trials to improve the percentage of saccharine matter in the beetroot, which has been elevated from 5 per cent. saccharine matter seventy years ago to 12 to 15 per cent. now ; in applying every new method which increases the return in sugar, the extraction of the juice by diffusion taking the highest place ; in a frequent check of the results obtained in practice by chemical analysis, by which defects in manufacture can be detected and the value of new improvements can be shown.

## BIBLIOGRAPHICAL NOTES.

W. O. Crosby. Notes on the Physical Geography and Geology of Trinidad. (Proc. Boston Soc. Nat. Hist., vol. xx., October, 1878.)

Some very valuable remarks on the Geology and Physical Geography of Trinidad are included in this paper,

W. O. Crosby. Native Bitumens and the Pitch Lake of Trinidad. (American Naturalist, April, 1879.)

Robert Elwes. W. S. W., A Voyage in that direction to the West Indies. London, 1866. 8vo., pp. 96—135.

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A new spider (*Gasteracantha callida*) from Trinidad is described by the Rev. O. P. Cambridge in Proc. Zool. Soc., 1879, p. 284, pl. xxvi., f. 7.

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A small round body, found somewhat abundantly in the tertiary rocks of Jamaica and Cumana, proves to be, as no doubt has been often suspected, a foraminifer, and has been described under the name of Tinoporus pilaris Brady, in an appendix to a paper by Profs. T. Rupert Jones and W. K. Parker on the Foraminifera, etc., of Jamaica. (Ann. Soc. Malacologique de Belgique, 1876.)

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## Rules and Regulations of the Scientific Association of Trinidad—1879.

*The object of this Association is the cultivation of Scientific Knowledge in the West Indies.*

### RULES.

1. This Association shall be called the "Scientific Association of Trinidad."

2. The objects of the Association shall be carried out by the reading of papers and the discussion of Scientific subjects, by maintaining a correspondence with scientific men in other countries, by assisting in the development and application of Science in the West Indies, and generally by the collection and publication of useful information.

3. The Association shall consist of Members, Corresponding Members, and Honorary Members.

4. The Association shall, in October of each year, elect from among the Members a President, two Vice-Presidents, and a Secretary and Treasurer, who shall constitute the Council of the Association. Such Council shall have, subject to the Rules, the general management of the affairs of the Association.

5. The person who shall have filled the office of President for two consecutive years shall not be elligible as President for the next following year.

6. Candidates for admission as Members must be proposed in writing by at least two Members of the Association.

7. When any candidate shall be proposed for admission to the Association as a Member, he shall be balloted for at the next meeting thereafter, one black ball in five excluding.

8. The Association may elect as Corresponding Members such persons in the West Indies and elsewhere as, from their services to Science, are likely to contribute towards the advancement of the objects of the Association.

9. The Association may elect as Honorary Members such persons not permanently resident in Trinidad, as may be desirable.

10. The Association shall meet on the second Wednesday in each month, or on such other day as may be fixed by the Council.

11. No motion relative to the Rules of the Association shall be brought forward except at a Special General Meeting of the Association; and no such motion shall be carried, except by a majority of at least two-thirds of the Members present at such Special General meeting.

12. One-third at least of the Members of the Association actually in the Island shall be required to constitute a Special General Meeting; and in order to constitute such Special General Meeting, it shall be requisite to give notice thereof at an ordinary Meeting.

13. Provided, however, that the ordinary Meeting in October of each year shall have all the powers of a Special General Meeting, without respect to the number of Members present.

14. The Subscription of each Member shall be Five Dollars per annum, payable on the first day of October. Every new Member on election shall pay the subscription for the current year.

15. No Member whose subscription shall be in arrear for three calendar months, unless at the time absent from the Island, shall be entitled to any of the privileges of membership.

16. The Secretary shall, at the monthly meeting in February of each year, lay before the Association lists of those Members whose subscriptions are in arrear.

17. Members may introduce strangers to the meetings, provided that no person shall be considered a stranger after he shall have been resident in the Island three calendar months.

18. Every Member shall be entitled to one copy of each paper printed since his election.

19. No Member shall be entitled to receive free any paper published during any period for which he shall not have paid subscription.

20. The author of every paper printed for the Association shall be entitled to have ten copies of such paper.

21. Members desiring to obtain copies of the Proceedings of the Association, other than those to which they are entitled as specified in the preceding Rules, may have the same, as far as copies are available, on payment of the following rates :—

When the part of the half-yearly Journal shall not exceed 32 pages (for each part) ... ... ... ... ... 2s. 0d.
When the same shall exceed 32 pages (for each part) ... 3s. 0d.

22. Copies of the Journal of Proceedings of the Association may be sold to the public at the following rates :—

When the part of the half-yearly Journal shall not exceed 32 pages (for each part) ... ... ... ... ... 3s. 6d.
When the same shall exceed 32 pages (for each part) ... 5s. 0d.

A Commission at the rate of twenty-five per cent. shall be allowed to the Agent appointed for the sale of such Journal; and the monies derived from the sale of papers shall be applied to the purposes of the Association.

23. Corresponding Members not being required to pay any subscription may receive the parts of the "Proceedings" at the price charged to Members.

24. Corresponding and Honorary Members desirous of receiving the publications of the Association are required to pay an annual sum of Five Shillings, for which the publications of the Association will be sent to them, post-free.

25. These Rules shall not be applicable to Honorary or Corresponding Members, unless where expressly so stated.

## List of Members.

1873. John Arnold, L.R.C.P.
1878. Washington Arrowsmith.
1879. Robert Gervase Bushe, B.A.
1878. Thomas William Carr.
1871. Samuel Leonard Crane, M.D.
1877. Sylvester Devenish, M.A.
1877. Ferdinand Aimé de Verteuil, M.R.C.S.
1874. James Andrews de Wolff, M.D.
1864. Robert Guppy, M.A.
1863. Robert John Lechmere Guppy, C.M.Z.S.
1879. J. B. Hutton.
1868. Robert Knaggs, M.R.C.S.
1879. Henry Ludlow.
1879. John McCarthy, F.C.S.
1877. Robert Dawson Mayne.
1878. Philip Henry Nind, B.A.
1864. Henry Prestoe.
1874. John Edward Tanner, M.I.C.E.

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## Honorary Members.

His Excellency The Hon. Sir Arthur Gordon, G.C.M.G.
His Excellency Sir Rawson W. Rawson, K.C.M.G.
His Excellency Sir James R. Longden, K.C.M.G.

Transfd from Geol Dept
5 MAY 1886